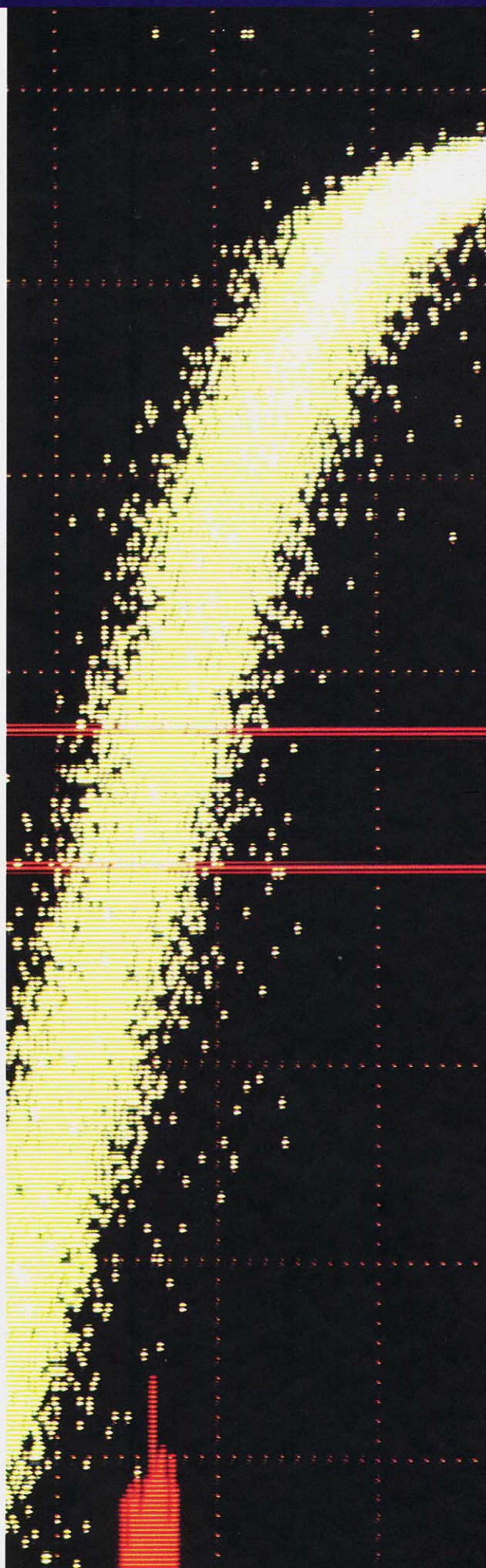
Tektronix

Test and Measurement

Product Catalog 1993



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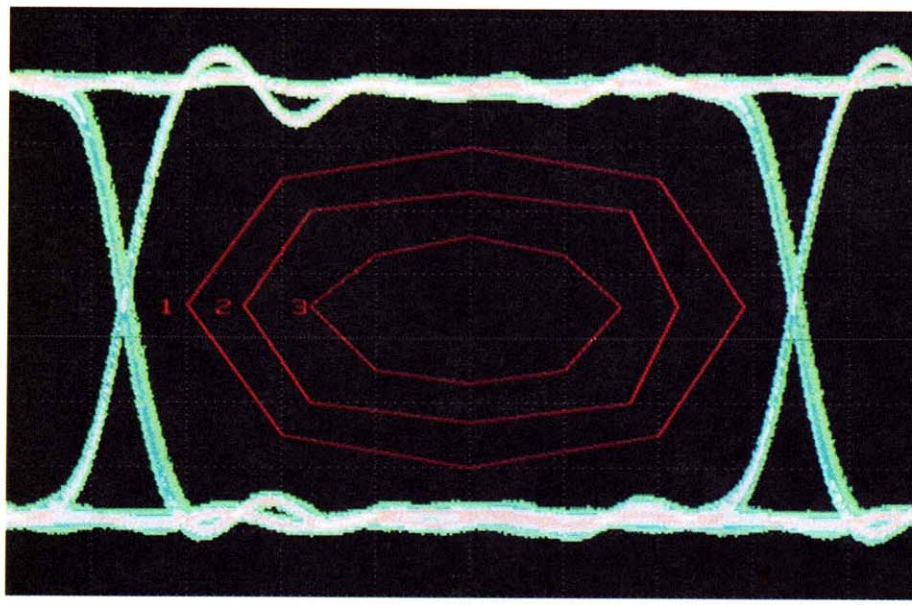
Product Catalog
1993



Introduction

Welcome to the Tektronix 1993 Test & Measurement Catalog. Tektronix is proud to present one of the world's broadest lines of problem-solving measurement tools, from handheld meters to computer-controlled test systems for production testing. There is a wealth of new products, and enhancements to many of our proven instruments. As you read through this catalog, you'll see our continued commitment to providing the best, most cost-effective solutions for your acquisition, analysis, and measurement needs.

The catalog opens with an applications matrix, a "snapshot" that introduces you to five typical application areas and how their requirements are met by Tektronix tools. On the subsequent pages, each of the five areas is discussed in greater detail with an overview of its measurement requirements and a true-life case study of a solution.

The New Product Section, pages 30 through 39, highlights some of our most notable new entries. Here we present the latest in scopes, telecommunications test equipment, spectrum and logic analyzers, probes, and more.

Also featured in this catalog are some of the newest offerings from Tektronix' Television and Computer Graphics groups. The Television Systems Group manufactures products and systems for the technical assessment, production, and production–related distribution of television programming.

The Computer Graphics Group operates in three areas of the computer peripherals industry— color printers, graphics terminals, and advanced displays. Tektronix is dedicated to providing continued leadership in the business presentation markets, from the leading–edge color printers and X terminals to innovative display products.

Our customer support section beginning on page 519, supplies helpful information to aid in your purchasing process and after sales support Tektronix provides. Tektronix has worldwide distribution channels, including many Authorized Distributors. To find the Tektronix office or Authorized Distributor nearest you, see pages 536 – 540.

Table of Contents

Alphanumeric Index **2-8**
Functional Index **9-16**
Market Focus Section **17-29**
- Recommended Solutions Matrix 18
- Avionics 20-21
- Telecommunications 22-23
- Education 24-25
- Industry 26-27
- Semiconductor 28-29

New Products Section **30-39**
Test and Measurement **41-490**
- Oscilloscopes 41
  - Reference 42
  - Digitizing/Digital + Analog Storage 49
  - Analog Storage 113
- Digitizers 131
- Logic Analyzers 151
- Spectrum Analyzers 185
- Personal Fourier Analyzers 216
- Multi-Channel Analyzers 220
- Telecommunications Instruments 224
- Digital Signal Processing System 256
- Systems, Controllers, Software 261
- Instrument Software 277
- Modular & Standalone General Purpose Test, Basic Bench Test Instruments 285
  - Arbitrary Function/Waveform, Function/Pulse Generators 286, 377
  - Stimulus Systems 314
  - Power Supplies 317, 388
  - Digital Multimeters 320, 372, 384
  - Digital Counters, Counters 326, 380
  - Modular Oscilloscopes 336
  - Audio Analyzers 342
  - Signal Conditioners 348
  - Modular Mainframes 351
  - Scope Calibration 358
  - Basic Bench Set 371
- Education Market Program 391
- Semiconductor Testers 395
- Photometer/Radiometer 404
- Accessories 407
  - Plotters, Video Copier, Film-based Cameras 408
  - Carts 418
  - Probes 423
  - Other Accessories 480
  - Anthro 515

Television Products **491-504**
Computer Graphics **505-512**
- Printers 506
- Terminals, Monitors 508-510

Microelectronics **513**
General Customer Support **519-540**
- General Information 520-521
- Warranty Summaries 522-523
- Service Offerings 524-527
- Reconditioned Instruments 528
- Training/Seminars, Application Notes 529, 532
- Purchasing/Ordering (GSA Contract), Power Cords/Plugs 530
- Sales/Service Offices (International, U.S.) ..... 536-539, Inside Back Cover

Alphanumeric Index

AA 5001 Programmable Distortion Analyzer 346
AA 501A Distortion Analyzer....346
AFG 2020 Arbitrary Function Generator....288
AFG 5102 Arbitrary/Function Generator....295
AFG 5502 Arbitrary/Function Generator....295
AM4001 Differential Amplifier 439
AM 501 Operational Amplifier 348
AM 502 Differential Amplifier 348
AM 503A Current Probe Amplifier 350, 446
AM 503S Current Probe Amplifier System 350, 446
Anthro Furniture 515
ASG 100 Audio Signal Generator 503
AVC-20 Audio Vector Converter....502
AWG2020 Arbitrary Waveform Generator 288
AWG5102 Arbitrary Waveform Generator 295
AWG5105 Arbitrary Waveform Generator 292
AWG5502 Arbitrary Waveform Generator 295
A1001 Blank Adapter....403
A1002 In-Line Adapter 403
A1003 TD3/TD66 Power Transistor Adapter 403
A1004 Offset Lead Adapter 403
A1005 Axial Lead Diode Adapter 403
A1006 Long Lead Transistor Adapter....403
A1007 Transistor Adapter 403
A1008 Long Lead FET Adapter 403
A1009 FET Adapter....403
A1010 IC Adapter 403
A1023 SMT Device Adapter....403
A1024 TD/SMT Device Adapter 403
A6302 50 MHz AC/DC Current Probe 350, 446
A6303 15 MHz AC/DC Current Probe 350, 446
A6501 Buffer Amplifier....440
A6901 Ground Isolation Monitor....457
A6902B Voltage Isolation Amplifier 456
BP1 Battery Pack....495
CAL93 LRL Calibration Substrate 471
CAL96 LRL Calibration Substrate 471
CAT200 Virtual Instrument Software 112, 278
CDC250 Universal Counter 380
CDM250 Digital Multimeter 384
CFC250 Frequency Counter....380
CFG250 Function Generator 377
CFG253 Function Generator 377
CFG280 Function Generator w/Counter 377
CG 5011 Programmable Calibration Generator....362
CMC250 Multifunction Counter 380
CMC251 Frequency Counter w/Time Base....380
CPS250 Power Supply....388
CrafTek™ Subscriber Loop Portable Test Set....242
CSA 404 Communications Signal Analyzer....246
CSA 803 Communications Signal Analyzer....250
CSA 907A Bit Error Rate Tester 254
CSI Link Symbol Conversion Software....161
CT-1 1 GHz Current Transformer....448
CT-100 CrafTek Portable Subscriber Loop Test Set....242
CT-2 200 MHz Current Transformer 448
CT-3 Signal Pickoff....482
CT-4 1,000 A Current Probe 448
C1002 High Resolution CCD Video Camera....411
C1002R Ruggedized High Resolution CCD Video Camera 411
C-30BP Camera for Portable Instruments....408
C-9 Low Cost Camera.... 408
DAC 422 D to A Converter 496
DAS92E9 8 Card Slot Expansion Mainframe....158, 164
DAS9200 Digital Analysis System....158
DAS9221 Digital Analysis Mainframe-Speed Enhanced 158
DAS9229 Digital Analysis Mainframe/Color Display 158
DAS9250 Single Microprocessor Support System 158
DAS9252 Single Microprocessor Support System 158
DAS9254 Dual Microprocessor Support System 158
DAS9281 High Performance Processor Support 158, 164
DAS9282 High Performance Processor Support 158, 164
DAS9283 High Performance Processor Support 158, 164
DAS9284 High Performance Processor Support 158, 164
DAS92E9 8 Card Slot Expansion Mainframe....158
DC 5009 Programmable 135 MHz Universal Counter/Timer....330
DC 5010 Programmable 350 MHz Universal Counter/Timer....328
DC 503A 125 MHz Universal Counter 334
DC 504A 100 MHz Counter/Timer....332
DC 509 135 MHz Universal Counter/Timer 330
DC 510 350 MHz Universal Counter/Timer 328
DCS01 Digitizing Camera System 411
DITS Digital Interface Test System 245
DL-11 Delay Line 94
DM 250 Digital Multimeter 372
DM 251 Handheld Digital Multimeter....372
DM2510 Programmable Digital Multimeter 384
DM2510G Programmable Digital Multimeter 384
DM252 Handheld Digital Multimeter....372
DM 253 Component Checker....372
DM254 Handheld Digital Multimeter....372
DM 504A Digital Multimeter 324
DM 511 Digital Multimeter 321, 322
DM 5110 Programmable Digital Multimeter 321, 322
DP 501 Digital Prescaler....332
DSA 601A Digitizing Signal Analyzer....68
DSA 602A Digitizing Signal Analyzer....68
DX01 DCS Frame Store Board 411
DX02 C1001/2/2R Power Supply/Video Interface 411
DX05 Video Monitor 411
EPC-2 C-Size Controller....268, 272
EPC-7B C-Size Controller....268, 272
EPC-7D C-Size Controller....268, 272
EPC-7D1 International Development System 268, 272
EPC-7R C-Size Controller....268, 272
EPC-7R1 International Development System 268, 272
EZ-TEST Test Development Software 278, 281
FG 5010 Programmable 20 MHz Function Generator....302
FG 501A 2 MHz Function Generator 304
FG 502 11 MHz Function Generator 304
FG 503 3 MHz Function Generator 304
FG 504 40 MHz Function Generators....302
FiberChamp Optical Power Meter....240
FiberMaster Optical Time Domain Reflectometer....236
FiberScout Handheld Optical Fault Finder 238
GRASP General RF Applications Software 209, 278
HCM08 Video Copier Multiplexer....414
HC02A Video Copier/Printer....414
HC100 Color Plotter....416
HFS 9DG1 Data Time Generator Card....314
HFS 9DG2 Data Time Generator Card....314
HFS 9PG1 Pulse Generator Card 314

Color identifies NEW products.

Alphanumeric Index

HFS 9PG2 Pulse Generator Card 314
HFS 9003 Stimulus System 314
HFS 9009 Stimulus System 314
J17 Digital Photometer/Radiometer 404
J1803 Luminance Probe 404
J1805 Head for LEDs 404
J1806 Radiance/Radiant Head 404
J1811 Illuminance Head 404
J1812 Irradiance Head 404
J1820 Chromaticity Head 404
K212 Portable Instrument Cart 419
K217S Rack Instrument Cart 419
K218 TDS 500 Series Cart 420
K220 Rack Instrument Cart 420
K318 Utility Cart 421
K335BN Workstation 422
K636 Mobile Workstation 422
LA Link Symbol Conversion Software 161
LabView Graphical Programming Software 274, 278
LabWindows Programming Environment Software 274, 278
LDC600 Laser Driver/Controller 513
LDM1300 Laser Diode Module 513
LDM1301 Laser Diode Module 513
LDM1550 Laser Diode Module 513
LDM1551 Laser Diode Module 513
LV511 ASIC Verification System 166
LV512 ASIC Verification System 166
LV513 ASIC Verification System 166
LV514 ASIC Verification System 166
MUX16 DCS Expansion Mainframe 411
MXIPCDOS MXIbus Interface Kit 272
MXIPCWIN MXIbus Interface Kit 272
MXISUN MXIbus interface Kit 272
MXIVXI MXIbus Interface Kit 272
NU 900M Display Monitor 512
OA5002 Optical Attenuator 235
OA5012 Optical Attenuator 235
OA5022 Optical Attenuator 235
OCP 5002 Optical Converter/Power Meter 230
OCP 5502 Optical Converter/Power Meter 230
OF150 Fiber Optic TDR 241
OIG 501 Optical Impulse Generator 234
OIG 502 Optical Impulse Generator 234
OME1000 Standard Platform Test System 264
OME1100 Electrical Sensors Test System 265
OME1200 Avionics Subsystems Test System 265
OME1300 Semiconductor Characterization System 266
OME1400 Optical Communications Standards Test System 266
OME2000 Standard Platform Test System 264
OME2100 Electrical Sensors Test System 265
OME2200 Avionics Subsystems Test System 265
OME2300 Semiconductor Communications Standards Test System 266
OME2400 Optical Communications Standards Test System 266
ORS156 SDH/SONET Reference Receiver 228
ORS52 SDH/SONET Reference Receiver 228
ORS622 SDH/SONET Reference Receiver 228
PC486LW Controller 272
PC488LV Controller 272
PC 751 Remote Display Software 502
PE1000 PAL Encoder 499
PFG 5105 Pulse/Function Generator 300
PFG 5505 Pulse/Function Generator 300
PG 2010 Pulse Generator 308
PG 2011 Pulse Generator 308
PG 2012 Pulse Generator 308
PG 501 50 MHz Pulse Generator 313
PG 502 250 MHz Pulse Generator 312
PG 503 250 MHz Pulse Generator 312
PG 506A Calibration Generator 362
PG 508 50 MHz Pulse Generators 310
PG 5110 50 MHz Programmable Pulse Generator 310
Phaser (IISD, IIPXe, PXi, IIIPXi) Color Printers 506
PQFP100 Converter Clip 442
PQFP132 Converter Clip 442
PS280 Triple Output Power Supply 388
PS281 Single Output Power Supply 388
PS282 Single Output Power Supply 388
PS283 Triple Output Power Supply 388
PS 5004 Power Supply 317, 319
PS 5010 Programmable Triple Power Supply 317, 318
PS501-1 Power Supply 317, 318
PS 503A Triple Power Supply 317, 319
P400 1X Voltage Probe for 22X Oscilloscopes 455
P6006 35 MHz, 10X Probe 464
P6007 20 MHz, 1.5 kV, 100X Probe 454
P6008 100 MHz, 10X Environment Probe 459
P6009 120 MHz, 1.5 kV, 100X Probe 454
P6015A 75 MHz, 40 kV, 1000X Probe 455
P6021 60 MHz Current Probe 449
P6022 120 MHz Current Probe 449
P6046 Active Differential Probe 452
P6053C 200 MHz, 10X Probe 464
P6062B 100 MHz, 10X or 1X Probe 464
P6063B 200 MHz, 10X or 1X Probe 464
P6101B 15 MHz, 1X Probe 462
P6102A 60 MHz, 10X Probe 464
P6103B 50 MHz, 10X Probe 462
P6105A 100 MHz, 10X Probe 464
P6106A 250 MHz, 10X Probe 464
P6108A 100 MHz, 10X Probe 464
P6109B 150 MHz, 10X Probe 462
P6119B 1X/10X Switchable Probe 462
P6122 100 MHz, 10X Probe 464
P6129B 1X/10X Probe 462
P6130 250 MHz, 10X Probe 466
P6131 300 MHz, 10X Probe 466
P6133 150 MHz, 10X Probe 466
P6134C 10X Probe 466
P6135A 150 MHz, 10X Passive Differential Probe Pair 453
P6136 350 MHz, 10X Probe 466
P6137 400 MHz, 10X Probe 466
P6138 350 MHz, 10X Probe 466
P6139A 500 MHz, 10X Probe 466
P6149A 50 MHz, 10X Probe 464
P6150 9 GHz, High BW, Low Z 436
P6156 3.5 GHz, Low Z 436
P6201 900 MHz, 1X/10X/100X, FET Probe 434
P6202A 500 MHz, 10X/100X, FET Probe 434
P6203 1 GHz, 10X, Bipolar Probe 432
P6204 1 GHz, 10X, FET Probe 432
P6205 750 MHz, 10X, FET Probe 432

Color identifies NEW products.

Alphanumeric Index

P6206 1 GHz, SMA FET Probe 430
P6207 4 GHz, SMA FET Probe 430
P6217 4 GHz, TEKPROBE FET Probe 432
P6231 1.5 GHz, 10X, Bias-Offset Probe 432
P6302 Current Probe (see A6302)
P6303 Current Probe (see A6303)
P6407 Word Recognizer Probe 460
P6408 Word Recognizer Probe 460
P6420 1 GHz, 1X RF Probe 459
P6444 Data Acquisition Probe 183
P6460 Data Acquisition Probe 183
P6461 Data Acquisition Probe 183
P6461E Data Acquisition Probe 183
P6463A Data Acquisition Probe 183
P6464 Data Acquisition Probe 183
P6465 Data Acquisition Probe 183
P6480 Data Acquisition Probe 184
P6486 Data Acquisition Probe 184
P6487 Data Acquisition Probe 184
P6490 Data Acquisition Probe 176
P6501 750 MHz, Microprobe 440
P6507 1 GHz, Microprobe 440
P6511A 300 MHz, Spring Contact Fixtured Probe 440
P6513A 300 MHz, Spring Contact Fixtured Probe 440
P6562 350 MHz, 10X SMT Probe 442
P6602 Temperature Probe 459
P6701A Optical-Electrical Converter 226
P6703A Optical-Electrical Converter 226
P6711 Optical-Electrical Converter 226
P6713 Optical-Electrical Converter 226
P6721 Optical-Electrical Converter 226
P6751 Spatial Input Head 226
P850 10X Voltage Probe for 22X Oscilloscopes 455
Quickstart Operator's Package 98
RF160 Down Converter 259
RF162 Down Converter 259
RIC386 Controller 272
RTD 710A Programmable Waveform Digitizer 138
RTD 720A Fast Transient Digitizer 135
SA-42 Optical to Electrical Converter 232
SA-46 Optical to Electrical Converter 232
SCAL101 Oscilloscope Calibration System 366
SCAL102 Oscilloscope Calibration System 366
SCD1000 Ultra High Speed Transient Digitizer 132
SCD5000 Ultra High Speed Transient Digitizer 132
SC 501 5 MHz Oscilloscope 340
SC 502 15 MHz Dual Trace Oscilloscope 338
SC 503 10 MHz Dual Trace Storage Oscilloscope 338
SC 504 80 MHz Dual Trace Oscilloscope 337
SD-14 High Impedance Probe Sampler 90
SD-20 Loopthrough Sampling Head 90
SD-22 Low Noise Sampling Head 90
SD-24 TDR Sampling Head 90
SD-26 Sampling Head 90
SD-30 Sampling Head 90
SD-32 Sampling Head 90
SD-42 Optical to Electrical Converter 90, 232
SD-46 Optical to Electrical Converter 90, 232
SD-51 20 GHz Trigger Head 90
SG 502 Oscillator 364
SG 503 250 MHz Leveled Sine-Wave Generator 364
SG 504 1 GHz Leveled Sine-Wave Generator 364
SG 505 Low Distortion Oscillator 344
SG 5010 Programmable Low Distortion Oscillator 344
SG 5030 Programmable Leveled Sinewave Generator 364
SIU 800 Static Isolation Unit 94
SI 5010 Programmable Scanner 341
SMCK1 SOIC Clips 442
SMGK51 SMT KlipChip Pkg 442
SMGK52 SMT KlipChip Pkg 442
SMG50 SMT KlipChip Pkg 442
SMQK1 PLCC Quad Kits 442
SM-11 Multichannel Unit 94
SPARCIPC Sun Runtime System 272
SPARCIPX SUN Development System 272
SPG1000 HDTV Sync Generator 499
S2MG100 Enhanced Frequency Measurements 258, 278
S26EM00 EMI Prequalification Software 212, 278
S26EM12 Commercial EMI Test Software 212, 278
S26RF00 General RF Applications (GRASP) 209, 278
S26RM00 RSM Host-Site Module 209, 278
S26RM01 RSM Remote-Site Module 209, 278
S26UT00 278X Utility Software 209, 278
S26UT10 271X Utility Software 209, 278
S3FG200 GPIB Drivers 278
S3FG210 PC-GPIB Interface Card 278
S3FG220 AT-GPIB Interface Card 278
S3FG230 MC-GPIB Interface Card 278
S3FG909 LabWindows 274, 278
S3FG910 LabWindows Standard Package 274, 278
S3FG911 LabWindows Runtime Library 274, 278
S3FG912 LabWindows Advanced Analysis Library 274, 278
S3FG919 LabView PC Kit 274, 278
S3FG920 LabView PC Base 274, 278
S3FG921 LabView PC Base Analysis 274, 278
S3FG922 LabView PC Base RT 274, 278
S3FG923 LabView Sun Kit 274, 278
S3FG924 LabView Sun Runtime 274, 278
S3FT002 TekTMS Kit 274, 278
S3FT100 TekTMS Interactive Procedure Generator 274, 278
S3FT110 TekTMS Runtime Code Generator 274, 278
S3FT120 TekTMS FPE 274, 278
S3FT200 TekTMS VXI Instrument Library 274, 278
S3FT300 TekTMS GPIB Instrument Library 274, 278
S3FT400 WaveWriter 278, 282
S34TDS1 TDS Data Manager 63, 278
S41SAVE WaveSaver 2200 Series DSO Support 278, 279
S41TSS1 TeleServicing Support 2200 Series DSO 278, 279
S43R101 1230/PC RS232 Application. Software 182, 278
S45F030 EZ-TEST Test Development Software 281
S47P108 11000 Series DSO IBM PC Utility (Opt. 01) 278, 283
S48P104 370A Utility Software 278, 400
S48P105 371A Utility 278, 398
S48P401 370A Device Test Software 278, 399
S58DC01 DCS01/DX01 Software 278, 411
TAS455 60 MHz Analog Oscilloscope 114
TAS465 100 MHz Analog Oscilloscope 114
TD100 Data Manager Software 63
TD1301 Digitizer System 140
TDC Tunable Down Converter 504
TDC-10 Tunable Down Converter 504
TDS420 150 MHz Digitizing Oscilloscope 60

Color identifies NEW products.

Alphanumeric Index

TDS460 350 MHz Digitizing Oscilloscope....60
TDS520 500 MHz Digitizing Oscilloscope....56
TDS540 500 MHz Digitizing Oscilloscope....56
TDS620 500 MHz Digitizing Oscilloscope....56
TDS640 500 MHz Digitizing Oscilloscope....56
TDS820 6 GHz Digitizing Oscilloscope....54
TDS840 8 GHz Digitizing Oscilloscope....54
TekTMS Test Management System Software....274, 278
Teleservicing Integrated Teleservicing Support Software....278, 279
TFC200 FiberChamp Handheld Optical Power Meter....240
TFP2 FiberMaster....236
TFS 2020 FiberScout Fault Finder....238
TG 501A Time Mark Generator....362
TIC Tektronix Integration Center....267
TKAD10C A/D Converter....513
TKAD20C A/D Converter....513
TKDA10 D/A Converter....513
TKDD10P Video Display Driver....513
TMP9210 Microwave Probe....470
TMP9215 Microwave Probe....470
TMP9220 Microwave Probe....470
TMP9225 Microwave Probe....470
TMP9230 Microwave Probe....470
TMP9310 Microwave Probe....470
TMP9315 Microwave Probe....470
TMP9320 Microwave Probe....470
TMP9325 Microwave Probe....470
TMP9330 Microwave Probe....470
TMP9610 Microwave Probe....470
TMP9612 Microwave Probe....470
TMP9615 Microwave Probe....470
TMP9617 Microwave Probe....470
TMP9620 Microwave Probe....470
TMP9625 Microwave Probe....470
TMP9805 Microwave Probe....469
TMP9810 Microwave Probe....469
TMP9815 Microwave Probe....469
TMP9820 Microwave Probe....469
TM250 Basic Bench Set....371
TM 5003 Three-Wide Mainframe....353
TM 5006A Six-Wide Mainframe....353
TM 501A One-Wide Mainframe....354
TM 502A Two-Wide Mainframe....354
TM 503B Three-Wide Mainframe....354
TM 504 Four-Wide Mainframe....354
TM 506A Six-Wide Mainframe....354
TPG 625 Pattern Generator....500
TR 503 Tracking Generator....200
TSG 100 NTSC Signal Generator....497
TSG 1001 Programmable Generator....500
TSG 1050 HDTV Generator....499
TSG 111 PAL Signal Generator....497
TSG 1125 HDTV Generator....499
TSG 120 YC/NTSC Signal Generator....497
TSG 121 SVHS/PAL Signal Generator....497
TSG 1250 HDTV Generator....499
TSG 130A NTSC Multiformat Generator....497
TSG 131A PAL Multiformat Generator....497
TSG 170A TV Test Signal Generator....498
TSG 170D Digital Composite Generator....496
TSG 200 NTSC Signal Generator....497
TSG 202 NTSC Signal Generator....497
TSG 271 PAL TV Generator....498
TSG 273 PAL Composite Digital Signal Generator....496
TSG 300 Component TV Generator....499
TSG 370 Component/Composite TV Generator....499
TSG 371 Component/Composite TV Generator....499
TSG 422 Digital Component Generator....496
TVC 501 Time Interval to Voltage Converter....350, 450
US-1 Video Display Driver....513
US4DM1 Video Display Driver....513
VITS 100 NTSC Generator/Inserter....500
VITS 200 NTSC Generator/Inserter....500
VITS 201 Insertion Generator....500
VMBKUP Backup and Remote Control Software....493
VMREMGR Remote Graphics Software....493
VMT Remote Control Software....493
VM 700A Video Measurement Set....492
VS 210 NTSC Video Synchronizer....501
VS 211 PAL Video Synchronizer....501
VX1400 VXI C-Size Mainframe....268
VX1401 VXI C-Size Mainframe....268
VX1405A VXI C-Size Mainframe....268
VX1500 VXI D-Size Mainframe....268
VX1505 VXI D-Size Mainframe....268
VX4223 VXI C-Size Counter/Timer....269
VX4234 VXI 4.5 Digit Digital Multimeter....269
VX4236 VXI 6.5 Digit Digital Multimeter....269
VX4240 VXI Waveform Digitizer/Analyzer Module....269
VX4250 VXI Waveform Digitizer/Analyzer Module....269
VX4281 Power Meter....269
VX4286 Digital Input/Analog Comparator....269
VX4332 2 Wire Scanner Master....270
VX4334 4 Wire Scanner Slave....270
VX4342 Programmable Resistance....269
VX4353 SPST Relay Switch....270
VX4355 DPST/SPST Relay Switch....270
VX4356 DPDT Relay Switch....270
VX4357 SPDT Relay Switch....270
VX4363 SPST Low Cost Switch....270
VX4366 DPDT Low Cost Switch....270
VX4367 SPDT Low Cost Switch....270
VX4372 2 Wire Scanner Slave....270
VX4374 4 Wire Scanner Slave....270
VX4385 128 Relay Switch Matrix....270
VX4386 128 Latching Relay Switch Matrix....270
VX4440 VXI C-Size Scanner Master....270
VX4520 VXI Slot 0 Resource Manager....268
VX4521 VXI Advanced Resource Manager....268
VX4730 12 Channel DAC....269
VX4750 Function Generator....269
VX4790 Arbitrary Waveform Generator....269
VX5260A VXI D-Size Waveform Digitizer....269
VX5521 VXI D-Size Slot 0....268
VX5535 VXI D-Size System Controller....268
VX5790 VXI D-Size Arbitrary Waveform Generator....269
WaveSaver WaveSaver 2200 DSO Support Software....278, 279
WaveWriter Waveform Creation & Editing Software....278, 282
WFM 300A Component/Composite TV Waveform Monitor....495
WM780 Waveguide Mixers....199
WM782 Waveguide Mixers....192
XP11 X Terminal....509

Color identifies NEW products.

Alphanumeric Index

XP13 X Terminal....509
XP17 X Terminal....509
XP18 X Terminal....509
XP334 X Terminal....508
XP336 X Terminal....508
XP337 X Terminal....508
XP338 X Terminal....508
11A16 50 MHz Current Amplifier....83
11A32 400 MHz Amplifier....81
11A33 150 MHz Differential Comparator....82
11A34 300 MHz Amplifier....81
11A34V 300 MHz Video Amplifier....84
11A52 600 MHz Amplifier....80
11A72 1 GHz Amplifier....80
11A81 3 GHz Amplifier....79
11T5H Video Trigger....84
110-S Video Synchronizer....501
1101A Probe Power Supply....438
1102 Probe Power Supply....438
1103 TEKPROBE Power Supply....438
11402A 1 GHz Digitizing Oscilloscope....72
11403A 3 GHz Digitizing Oscilloscope....72
118-AS Audio Synchronizer....501
11801A Digital Sampling Oscilloscope....85
1230 Logic Analyzer....178
1230B Battery-Powered Logic Analyzer....178
1230D Logic Analyzer with Scope Card....178
1230DSM Digitizing Scope Card....178
1230E1 16 Channel Expander Card....178
134 Current Probe Amplifier....449
1405 TV Sideband Adapter....200
1450-1 TV Demodulator Mainframe....504
1450-2 TV Demodulator Mainframe....504
1450-3A TV Demodulator Mainframe....504
1502B TDR Cable Testers....244
1502C TDR Cable Testers....244
1503B TDR Cable Testers....244
1503C TDR Cable Testers....244
1705A Spectrum Monitor....504
1710B NTSC Waveform Monitor....494
1711B PAL Waveform Monitor....494
1720 Vector Monitor....494
1720 SCH NTSC Vectorscope....494
1721 Vector Monitor....494
1721 SCH PAL Vectorscope....494
1725 PAL/NTSC Vectorscope....494
1730 D NTSC Serial Digital Waveform Monitor....494
1730 D2 Waveform Monitor....494
1731 PAL Waveform Monitor....494
1731 D PAL Serial Digital Waveform Monitor....494
1731 D2 PAL Waveform Monitor....494
1735 PAL/NTSC Waveform Monitor....494
1735 HD Multiformat Waveform Monitor....495
1740A NTSC Waveform/Vector Monitor....495
1741A PAL Waveform/Vector Monitor....495
1745A NTSC/PAL Waveform/Vector Monitor....495
1750A NTSC Waveform/Vector Monitor....495
1751A PAL Waveform/Vector Monitor....495
1755A NTSC/PAL Waveform/Vector Monitor....495
1760 NTSC Composite/Componenet Waveform/Vector Monitor....495
1761 PAL Composite/Componenet Waveform/Vector Monitor....495
1765 PAL Composite/Componenet Waveform/Vector Monitor....495
177 Standard Test Fixture....401
1780R Video Measurement Set....493
1781R Video Measurement Set....493
1910 Digital Generator/Inserter....498
2000PTD High Capacity Transfer Disk System....144
2000AM Air Management Module....144
2000AZ1 Interactive Control Software....144
2000B 5 Slot VME Chassis....144
2000BBM Battery Backed Module....144
2000BR Rackmount Chassis....144
2000CBI Cache Memory Interface Cable....149
2000CBM Digital Interface Cable....144
2000CBR Custom Ribbon Cable....149
2000CS Series 2000 Control Software....144
2000CV1 5 Slot Chassis Conversion Kit....144
2000CV2 10 Slot Chassis Conversion Kit....144
2000DM1 14 inch Monochrome Monitor....144
2000HA High Throughput Accelerator Module....144
2000IRG IRIG Timing Module....144
2000MC Serial Mouse....144
2000P Processor Module....144
2000PDA High Capacity Parallel Disk Array....144
2000RH1 12 Slot Horizontal VME Chassis....144
2000RV1 10 Slot Vertical VME Chassis....144
2000RV2 20 Slot Vertical VME Chassis....144
2000SS1 2 CH, 1 GS/s Signal Splitter....144
2000SS2 2 GS/s Signal Splitter....144
2000SS3 2 CH, 500 MS/s Signal Splitter....144
2000SS4 1 CH, 500 MS/s Signal Splitter....144
2000SS8 Signal Splitter....144
2000T Standard Timing Module....144
2000TD Timing Distributor Module....144
2002MI Memory Interface Module....144
2004A Amplifier/Attenuator Module....144
2004HS1 High Throughput Sampling Subsystem....144
2004HS2 High Throughput Sampling Subsystem....144
2004S Standard Sampling Module....144
2004SC High Throughput Sampling Module....144
2008GC Gated Clock Module....144
2008MM 8 Mbyte Cache Memory Module....144
2008S 8 CH Standard Sampling Module....144
2016MM 16 Mbyte Cache Memory Module....144
2016S 16 CH Standard Sampling Module....144
2032LC 32 CH Dual Range Sampling Module....144
2032MM 32 Mbyte Cache Memory Module....144
2064MM 64 Mbyte Cache Memory Module....144
206 SCOPE-MOBILE® Carts....421
2201 20 MHz Digital + Analog Scope....104
2205 20 MHz Oscilloscope....128
2212 60 MHz Digital + Analog Scope....102
222A 10 MHz Handheld Oscilloscope....110
222PS 10 MHz Handheld Oscilloscope....110
2221A 100 MHz Digital + Analog Oscilloscope....106
2232 100 MHz Digital + Analog Scope....106
224 10 MHz Handheld Oscilloscope....110
2245A 100 MHz Oscilloscope....123
2247A 100 MHz Oscilloscope w/Voltmeter/Counter/Timer....123

Color identifies NEW products.

Alphanumeric Index

2252 100 MHz, Programmable Oscilloscope 123
2402A TekMate Instrument Extension....98
2410 Digital Interface Test System 245
2430A 100 MS/s, 150 MHz Digitizing Oscilloscope....97
2430A Opt. 46 150 MHz Digitizing Oscilloscope....100
2430M 2430 Digitizing Oscilloscope w/MATE/CIIL 100
2440 500 MS/s, 300 MHz Digitizing Oscilloscope....97
2440M 2440 Digitizing Oscilloscope w/MATE/CIIL 100
2445B 150 MHz Four Channel Oscilloscope....118
2465B 400 MHz Four Channel Oscilloscope....118
2467B 400 MHz High Writing Speed Oscilloscope....118
2467BHD HDTV Oscilloscope 118
25AA1 4 Different Channels....221
25AA2 2 Single Ended Channels....221
25AD3 Analog/Digital Acquisition Card....221
2505 TestLab 220
2505S11 TestLab 222
2505S13 TestLab 222
2510 TestLab 220
2510S1 TestLab 222
2510S11 TestLab 222
2510S12 TestLab 222
2510S13 TestLab 222
2510S2 TestLab 222
2510S21 TestLab 222
2510S22 TestLab 222
2510S23 TestLab 222
2520 TestLab 220
2622 Fourier Analyzer 216
2630 Fourier Analyzer 216
2642A Fourier Analyzer 216
2704 Inverter 215
2705 Battery Pack....215
2706 Stepping RF Selector 213
2711 Portable Spectrum Analyzer....201
2712 Portable Spectrum Analyzer....201
27120 EMC Measurement System....211
2714 Cable TV Spectrum Analyzer 205, 504
2721 Non-interfering Sweep Transmitter....504
2722 Non-interfering Sweep Receiver....504
2782 High Performance Microwave Spectrum Analyzer 187
2784 High Performance Microwave Spectrum Analyzer 187
2792 Programmable Spectrum Analyzer....193
2794 Programmable Spectrum Analyzer....193
2795 Programmable Spectrum Analyzer....193
2797 Programmable Spectrum Analyzer....193
30DA01 Performance Analysis Software 176
30DD27 Prototype Debug Tool Support Package-68000....176
30DD31 Prototype Debug Tool Support Package-68020....176
30DD33 Prototype Debug Tool Support Package-68030....176
30DM04 Microprocessor Support Package-8086/88 177
30DM06 Microprocessor Support Package-80816/188 177
30DM07 Microprocessor Support Package-8031/8051 177
30DM08 Microprocessor Support Package-286....177
30DM09A Microprocessor Support Package-386....177
30DM10 Microprocessor Support Package-3865X 177
30DM101 Microprocessor Support Package-DSP 56000/1....177
30DM27 Microprocessor Support Package-68000....177
30DM31 Microprocessor Support Package-68020....176
30DM33 Microprocessor Support Package-68030....177
30DM41 Microprocessor Support Package-780....177
30DM41F Microprocessor Support Package-780....177
30DM91 Microprocessor Support Package-68HC11 177
30DM92 Microprocessor Support Package-68302....177
30DM93 Microprocessor Support Package-68332....177
30DM993 Microprocessor Support Package-CPU32....177
30DSM Digitizing Oscilloscope Module 168, 173
30HSM High-Speed Acquisition Module....168, 172
30RP2 Prototype Debug Tool Support Package 176
3001GPX 80 CH General Purpose Logic Analyzer....174
3001HSM High-Speed Logic Analyzer 174
3001MPX 8/16/32 Bit Logic Analyzer 174
3002C Modular 3000 Series Color Mainframe 174
3002CG 80 CH General Purpose Logic Analyzer....174
3002CGD General Purpose/DSO Logic Analyzer 174
3002CGG 160 CH General Purpose Logic Analyzer....174
3002CGH General Purpose/High Speed Timing Logic Analyzer....174
3002E 3000 Series Expansion Mainframe....174
3002P Modular 3000 Series Portable Mainframe....174
3052 Digital Signal Processing System 256
32DM02 Prototype Debug Tool Support Package-8085....176
32DM04 Prototype Debug Tool Support Package-8086/88....176
32DM06 Prototype Debug Tool Support Package-80186/188 176
32DM07 Prototype Debug Tool Support Package-8031/8051.176
32DM08 Prototype Debug Tool Support Package-286....176
32DM09 Prototype Debug Tool Support Package-386....176
32DM10 Prototype Debug Tool Support Package-386SX....176
32DM101 Prototype Debug Tool Support Package-DSP56000/1 176
32DM12 Prototype Debug Tool Support Package-486....176
32DM122 Prototype Debug Tool Support Package-TMS320/C25....176
32DM24 Prototype Debug Tool Support Package-6809....176
32DM27 Prototype Debug Tool Support Package-68K....176
32DM31 Prototype Debug Tool Support Package-68020....176
32DM33 Prototype Debug Tool Support Package-68030....176
32DM34 Prototype Debug Tool Support Package-68040....176
32DM41 Prototype Debug Tool Support Package-780....176
32DM91 Prototype Debug Tool Support Package-68HC11 176
32DM92 Prototype Debug Tool Support Package-68302....176
32DM93 Prototype Debug Tool Support Package-68330/1/2..176
32DM96 Prototype Debug Tool Support Package-68HC16 176
32GPX General Purpose Acquisition Module 175
32PA Performance Analysis Software 176
370A Programmable Curve Tracer 398
371A Programmable Curve Tracer 400
372 Semiconductor Workbench....396
4684 Phaser IISD....506
469LAM Phaser Media Laminator 506
4698PXi Phaser III PXi....506
53A-226 Thermocouple....269
53A-310 FET Scanner Master 270
53A-311 FET Scanner Slave 270
53A-323 RF Switch (650 MHz)....270
53A-324 Microwave Scanner (18 GHz) 270
53A-519B 16 Channel Digitizer....269
53B CDSbus 10 Slot Mainframe....268
571 Curve Tracer 402
577D1 Storage Curve Tracer Mainframe 501
606B High Resolution Waveform Monitor....510

Color identifies NEW products.

Alphanumeric Index

608 High Brightness Waveform Monitor....510
620 General Purpose Waveform Monitor....510
63B CDSbus 5 Slot Mainframe....268
64B CDSbus 6 Slot Mainframe....268
728D NICAM Decoder....502
728E NICAM Encoder....502
73A-270 VXI Pulse/Pattern Generator....269
73A-308 VXI Relay Driver Module....270
73A-541 VXI Universal Digitizer Counter....269
751 Aural Modulation Monitor/Decoder....502
760A Stereo Audio Monitor....503
760D Sereo Audio Monitor....503
760N Stereo Audio Monitor....503
92A16 200 MHz Acquisition Card....164
92A16E 200 MHz Expansion Card....164
92A60 Data Acquisition Module/20 MHz Acquisition Card....164
92A90 20 MHz Acquisition Card....164
92A90D 20 MHz Acquisition Card....164
92A96 100 MHz Acquisition Card....164
92A96D 100 MHz Acquisition Card....160
92A96SD 100 MHz Acquisition Card....160
92A96XD 100 MHz Acquisition Card....160
9503 Fast Data Cache Unit....142
9504 Fast Data Cache Unit....142
92DM03 Microprocessor Support Package – 8086....163
92DM04 Microprocessor Support Package – 8088....163
92DM05 Microprocessor Support Package – 80186....163
92DM06 Microprocessor Support Package – 80188....163
92DM08 Microprocessor Support Package – 80286....163
92DM09A Microprocessor Support Package – 80386DX....163
92DM10 Microprocessor Support Package – 80386DX....163
92DM12 Microprocessor Support Package – 80486....163
92DM15 Microprocessor Support Package – i860....163
92DM17 Microprocessor Support Package – 80960....163
92DM24 Microprocessor Support Package – 6809/6809E....163
92DM27 Microprocessor Support Package – 68000/68010....163
92DM31A Microprocessor Support Package – 68020....163
92DM33A Microprocessor Support Package – 68030....163
92DM34 Microprocessor Support Package – 68040....163
92DM35A Microprocessor Support Package – 88100....163
92DM41 Microprocessor Support Package – Z80....163
92DM64 Microprocessor Support Package – 1750A....163
92DM72A Microprocessor Support Package – 29000/050....163
92DM74 Microprocessor Support Package – R3000....163
92DM77A Microprocessor Support Package – SPARC....163
92DM901 Microprocessor Support Package – MCS-51....163
92DM902 Microprocessor Support Package – 8085....163
92DM909 Microprocessor Support Package – VME....163
92DM912 Microprocessor Support Package – 68000/10....163
92DM913 Microprocessor Support Package – Z80....163
92DM914 Microprocessor Support Package – 96002....163
92DM916 Microprocessor Support Package – 80960KA/KB/MC....163
92DM920 Microprocessor Support Package – TMS320C3X....163
92C02 DAS GPIB Card....165
92F221 DAS Mainframe Upgrade....165
92F221X DAS Mainframe XTerm Upgrade....165
92HS8 2 GHz Acquisition Card....164
92HS8E 2 GHz Expansion Card....164
92LANSE Digital Analysis System....161
92S16 50 MHz Pattern Generator....164
92S32 50 MHz Pattern Generator....164
92SX109 100 MHz Pattern Generator....164
92SX118 100 MHz Pattern Generator....164
92XTERM Digital Analysis System....161
92LANP DAS LAN Remote Control SW....165

Color identifies NEW products.

Functional Index

A

Accessories 407-490
- Accessory Pouch 357
- Attenuators 482-483
- Cables 227, 480
- Cameras 408-413
- Capacitors, Coupling 482
- Carrying Cases 409, 488
- Carts 418-422
- Coaxial Cables 480
- Connectors, Coaxial 481
- Converter Probes (Optical) 226-227
- Delay Lines (SMA) 480
- Documentation Devices *see Cameras, Plotters & Printers*
- EMC Screen Filters 485
- Filters 485
- GPIB Cables 480
- Ground Leads, Probes 183, 184, 472-479
- Interface Cables (RS-232C, GPIB, Centronics) 480
- Isolators 456-458
- Light Filters 485
- Meter Leads 480
- Optical-to-Electrical Converter 226-233
- PLCC, SOIC Clips 442-443
- Plotter 416-417
- Power Dividers (SMA) 482
- Power Supplies 215, 317-319, 388-389, 438
- Probe Accessories 472-483
- Probes 423-483
- Product Accessories
  - Curve Tracers 403, 407-490
  - Digitizers 407-490
  - Logic Analyzers 183-184, 407-490
  - Modular Instruments 356-357, 407-490
  - Oscilloscopes 407-490
  - Plotters 416-417
  - Printers 414-415, 506-507
  - Rackmount Kits 486-487
  - Spectrum Analyzers 191, 192, 198, 199, 204, 208, 214, 215, 407-490
  - Telecommunications 224, 407-490
  - Television 480-490
- Terminations 482-483
- Test Leads 480
- Transit (Carrying) Cases 488
- Video Hard Copy 414-415
- Viewing Hoods 484

Active Probes (FET, Bipolar, Bias/Offset) **428**

Adapters
- BNC 481-483
- Cables, Fiber Optic 227
- Camera Mounting 410
- F 481-482
- GR 481-483
- Kits 480-481
- N 481-482
- Probe 474-483
- SMA (3 mm and 3.5 mm) 481-483

Amplifiers, Plug-In
- Current Probe 83
- Differential 348
- Differential/Comparator 82
- Dual Channel/Trace 80-81
- Four Channel/Trace 81, 144
- Operational 446
- Single Channel/Trace 79
- Video 84
- Waveform Digitizers 144

Analyzers
- Acoustic 216
- Audio 344-347
- Communications Signal 66-67, 246-253
- Control System 216
- Digital Signal 66-71
- Digitizing Signal 68, 72
- Distortion 68, 72, 346-347
- Fourier (FFT) 68, 72, 216
- Frequency 68, 72, 216
- Logic 151-184
- Multi-Channel 68, 72, 132, 135, 138, 144, 220
- Spectrum 185-215
- Structural 220-223
- Waveform 68, 72, 132, 135, 138, 144, 220

Antennas **214**

Application Notes Listing **532-535**

Arbitrary/Function Generators **287-297, 298-305**

Arbitrary Waveform Generators **286-295**

ASIC Verification System **166-167**

ASICs **514**

Attenuators **235, 482**
- Electrical 482
- Optical 235

Audio
- Aural Modulation Monitor/Decoder 502
- Distortion Analyzers 346-347
- Monitors 502
- NICAM Decoder 502
- NICAM Encoder 502
- Oscillator 344-345
- Signal Generator 502
- Stereo Audio Monitors 503
- Vector Converter 502

Automated Oscilloscope Calibration System **366-369**

Avionics **18-19, 20-21, 265**

B

Basic Bench Set **370**

Bench Test Instruments **370-390**

Bipolar Analog ICs **514**

Bit Error Rate Tester **254-255**

BNC
- Adapters 481-483
- Attenuators 482, 483
- Cables 480

C

Cable TV Measurements **205-208**

Cable Testers **236-239, 241, 244, 504**
- Metallic 244
- Optical 236-239, 241
- CATV/Broadband Sweep 504

Cables
- BNC, BSM, SMA (3 mm and 3.5 mm) 480
- Coaxial 480
- GPIB 480
- Interface (RS-232, GPIB, Centronics) 480
- Optical Fiber 227
- Patch Cords 480

Calibration Equipment **358-369**

Calibration Generator **362-363**

Functional Index

Calibration Services **524-527**
Calibration Systems **366**
Cameras **408-413**
Accessories 409
Carrying Case 409
Digitizing System 411
Film 409
Hoods, Scope and Video 409
Mounting Adapters 410
Selection Chart 410
Capacitors, Coupling (SMA) **482**
Card Modular Systems (VXI) **268-271**
Carrying Cases **409, 488**
Carts **418-422, 515**
Anthro™ 515
Controllers, PC 421
Curve Tracers 418
Digitizers 418
Logic Analyzers 418
Oscilloscope 418
Plotters/Printers 418
Rackmount 422
ScopeMobiles 418
Selection Guide 418
Spectrum Analyzers 418
Terminals 421
TV Products 418
Centronics Cables **480**
Chart Recorders **220**
Coaxial Cables **480**
Communication Interfaces
GPIB
Logic Analyzers 131-184
Oscilloscopes/Digitizers 49-129
Mate/CIL 97-100
Spectrum Analyzers 185-215
Waveform Capture System 144
VME
Waveform Capture System 144
VXI 268-271
Communications Signal Analyzers **66-67, 246-253**
Communications Test Equipment ***see Telecommunications***
Component Products/Services **514**
Integrated Circuits
Bipolar Analog ICs 514
Custom 514
Component Checker, Handheld **372**
Component Tester **372**
Computer
Furniture 515
Graphics Terminals 508-509
Software *see Software*
X Terminals 508
Connectors **481**
Controllers **268, 272**
Converters
A/D and D/A 513
Electrical-to-Optical 234
Optical-to-Electrical 226-233
Time to Voltage 350
Tunable/Fixed Down Converter, Television RF 504
Copiers, Video **414**
Counters **380-384**
Counters, Digital **326-335**
Counter/Timer
Modular 326-335
Oscilloscope 118, 123
VXI 269
Coupling Capacitors (SMA) **482**
Current Probes **444-449**
Curve Tracers ..... **395 - 403**
Adapters 403
Probes 407, 423-483
Custom ICs **514**
Custom Plug-in Kits **357**
Custom Systems **144, 268, 272**
Digitizer Test 144
Instrumentation & Control 144, 268, 272
Open Measurement 263, 267
Customer Information **267, 521-531**
GSA Contract 530
Leasing Program 530
Order Information *see Individual Product Pages*
Power Plug Options 530
Reconditioned Instruments 528
Rental Program 530
Sales & Service Offices 536-539
Service 524-527
Technical Support 267, 521
Terms of Sale 530
Training/Seminars 529
Warranty Summaries 522-523
Customer Service/Support **519-540**
Customer Training/Seminars **529**
D
Data Acquisition Systems **216-223**
Data Generators ***see Generators***
Data Time Generators ***see Generators***
Delay Lines (SMA) **480**
Demodulators, Television **504**
Development Modules (VXI) **268-271**
Differential Probes **452**
Digital Counter/Timers **326-335**
Digital Data Cache **142**
Digital Interface Test System **245**
Digital Multimeters (DMM)
Bench 384-385
Handheld 372-376
Modular 320-325
VXI.. 268-271
Digital Photometer/Radiometer **404-406**
Digital Prescaler **332**
Digital Signal Analyzer **66-71**
Digital Signal Processing Systems **216, 246-260**
Analyzers 256-260
Oscilloscopes 49-77, 85-89, 246-255
Software 274-281
Spectrum Analyzers 185-215
Waveform Capture System 144
Digital Verification Tools **151, 166**
ASIC Verification 166
Logic Analyzers 151
Digitizers ***also see Oscilloscopes*** **131-149**
Accessories 407-490
Camera System, Digitizing 411
CCD Video Camera 411
Fast Data Cache 142
GPIB 68, 72, 132, 135, 138, 144

Functional Index

High Speed Buffer 142
High Throughput 144
Imagers 411
Logic Analyzer Based 168-178
Multi-Channel 68, 72, 132, 135, 144
Programmable 68, 72, 132, 135, 144
Scan Converter 132
Systems 138, 144
Transient Capture 68, 72, 132, 135, 138, 144
VME 144
VXI 268-271
Waveform 68, 72, 132, 135, 138, 144, 268-261

Digitizing Signal Analyzers 68, 72

Display Devices *also see Monitors*
Color 510
Video Displays 411
X-Y 510
X Terminals 508

Distortion Analyzers 68, 72, 346-347

Distributors 540

Down Converters 259

Down Converters, Television RF 504

E

Education Support 18-19, 24-25, 391-394, 529
Hands-on Instruction 392
Self Study 392
Seminars 529
Training 529
Video Tapes 394

Educational Reps 540

Electromechanical Measurements 216-223

EMC Screen Filters 485

EMI Test Software 212

Environmental Probe 459

F

FDDI 230, 246-253

FET Probes 428-435

FFT 68, 72

Fiber Distributed Data Inteface Testing 230, 246-253

Fiber Optics 224-240

Film-Based Cameras *see Cameras*

Filters 485
EMC Screen 485
Light 485

Fixtured Probes 440-441

Floating Measurements 456-458

Fourier Analyzers 68, 72, 216

Frequency Analyzers 68, 72, 216

Frequency Counters 380-383

Function Generators 298-305, 377-379

Furniture *also see Carts*
Anthro® 515
Carts, Technology 418
PC Display Support 421
Technology 418
Workstation 418

G

Generator, Optical Impulse 234

Generators, Signal
Arbitrary/Function 286-297, 298-305
Arbitrary Waveform 286-297
Audio 502
Component 496, 499
Composite 496, 499
Data 314-316
Data Time 314-315
Digital 496, 498
Digital to Analog Converter 496
Digital Word 158
Function 286-291, 298-305, 377-379
High Definition 499
Insertion 498
Leveled Sinewave 364-365
Multiformat 497
NTSC 496-500
Optical Impulse 234
Oscillator 344, 364
PAL 496-500
Pattern 314-316, 500
Programmable Television 500
Pulse 288-316
Pulse/Function 298-301, 314-316
Serial Digital Video Interface 496
Sync 499
Television Test Signal 496-500
Time-Mark 362
Word 314-316
YC/NTSC 497

GPIB
Cables 480
VME Systems 144
VXI Systems 268-271

Graphics
Plotter, 4 pen 416-417
Printers *see Printers*
Software *see Software*
X Terminals 508

Ground Leads, Probe 183, 184, 472-479

H

Handheld Products 110-112, 240-241, 372-376, 384-385
ISDN Test Set 241
Multimeters 372-376, 384-385
Optical Power Meter 240
Oscilloscopes 110-112

High Definition 118, 495, 498-500
Generator/Inserter 498, 500
Television Generator 499
Television Oscilloscope 118
Television Sync Generator 499
Waveform Monitor 495

High Voltage Probes 428-435

Hoods, Scope and Video Viewing 484

Hybrid Components 513, 514

I

IC Clips 442-443
PLCC Packages 442-443
SOIC Packages 442-443

IC Design Tools 514

IC Manufacture
Bipolar Analog ICs 514
Custom ICs 514

ICs 514

Indices
Alphanumeric 2
Functional 9

Industry 18-19, 26-27

Inkjet Printers 506

Instrument Controllers *see System Controllers*

Functional Index

Instrument/Probe Reference Chart **424-425**
Instruments, Reconditioned **528**
Interface Cables **480**
Inverter/Battery Pack **215**

L

Laser Diode Modules **513**
Laser Driver/Controller **513**
Leasing Program **530**
Level Sinewave Generator **364-365**
Light Filters **485**
Light Measurement **226-240, 404**
- Fiber Optic 226-240
- Radiometer/Photometer 404-406

Line Impedance Stabilization Network **214**
Literature, Application Notes **532-535**
Logic Analyzers **151-184**
- Accessories 183-184, 407-490
- Battery-Powered 178
- Digital Analysis Systems 158
- Disassembly Probes 180
- General Purpose Analysis 178
- GPIB 155
- High Speed Timing 155
- Microprocessor 152, 155, 168-177
  - Disassembly 152, 155
  - Control 168-177
  - Support 155
- Oscilloscope, Digitizing 168-177
- Performance Analysis 168-177
- Selection Guide 155
- State Analysis 155-184
- Timing Analysis 155-184
- Training 182

Logic Trigger Probes **183-184, 460**
Low Capacitance Probes **436-437**
Low Impedance Voltage Probes **428-437**
Low-Distortion Oscillators **340-341**

M

Mainframes
- Digitizing Analyzers 68, 72
- Logic Analyzers 151-184
- Modular Instruments 144, 352-355
- Oscilloscopes 65-77, 85-89
- VME 144
- VXI 268-271
- Waveform Capture Systems 144

Market Focus Section **17- 29**
- Avionics 20, 21
- Education 24, 25
- Industry 26, 27
- Matrix 18, 19
- Semiconductors 28, 29
- Telecommunications 22, 23

Measurement Sets, Video **492**
Mechanical/Electromechanical **50, 216-223**
Meter Leads **480**
Microelectronics **513, 514**
Microwave & RF Instruments **183-215, 278, 407-490**
- Accessories 183-184, 407-490
- Microwave Comb Generator 198
- Software 209-210, 212, 278
- Spectrum Analyzers 185-215
- Spectrum Monitor 504
- Waveguide Mixers 192, 199

Modal Analysis **216-219**
Modular Instruments **144, 285-369**
- Accessories 356-357, 407-490
- Arbitrary/Function Generators 286-297
- Arbitrary Waveform Generators 286-297
- Audio Analyzers 342-347
- Custom Plug-In Kits 357
- Digital Counter/Timers 326-335
- Digital Multimeters (DMM) 320-325
- Digital Prescaler 333
- Digitizers 144
- Distortion Analyzers 346-347
- Frequency Counter 326-335
- Function Generators 286-305
- Leveled Sinewave Generators 364-365
- Logic Analyzers 151-184
- Low-Distortion Oscillators 340-341
- Mainframes 352-355
- Optical Converter/Power Meter 230
- Optical Impulse Generator 234
- Oscillator 364
- Oscilloscope Calibration 358-369
- Oscilloscopes 144, 336-340
- Power Supplies 317-319
- Pulse Generators 306-316
- SDH/SONET Reference Receivers 228
- Selection Guides
  - Arbitrary Generators 287
  - Digital Counters 327
  - Digital Multimeters 320
  - Function Generators 299
  - Modular Oscilloscopes 336
  - Oscilloscope Calibration 359
  - Power Supplies 317
  - Pulse Generators 307
- Signal Conditioners 348-350
- Signal Generators 344-345
- Signal Sources 286-316
- Software 278-281
- Switching 341
- Time Mark Generator 362
- Waveform Capture Systems 144

Monitors
- Color 510
- High Resolution Video 510
- Modulation (BTSC) 502
- Stereo Audio 503
- Vector 494
- Video 411
- Waveform 494, 510
- X-Y 510

N

New Products **30-39**

O

OEM Components **531**
Optical ***see Opto-Electronic Instruments***
Optical Attenuator **235**
Optical Communication Standards Test System **265, 266**
Optical to Electrical Converters **226-233**
Opto-Electronic Instruments
- Cable Testing, Optical 236-241
- Digital Photometer/Radiometer 404-406
- Generator, Optical Impulse 234
- Optical Attenuator 235

Functional Index

Optical to Electrical Converters 226-233
Optical-to-Electrical Converters
Heads 90-93, 232
Instruments 230
Modules 232
Probes 226
Power Meter, Optical 230, 240
Reference Receivers, SDH/SONET 228
Spatial Optical Fiber Input Head 226
Oscillator 364
Oscilloscope Calibration Instruments 358-369
Oscilloscopes
Accessories 407-490
Amplifiers 78-84
Analog 113-129
Analog Plus Digital 68, 72, 101, 132, 135, 138, 144
Battery Operated 110-112
BrightEye™ Transient Intensifying 118
Camera, Digitizing 411
Cameras 408
Carts/ScopeMobiles 418
Classroom, 20 MHz 128
Communications Signal Analyzer 65-67, 246-255
Counter/Timer 118, 123
Counter/Timer/DMM 118
Digital Sampling 68, 72, 132, 135, 138, 144
Digital Storage 50, 68, 72, 86, 97, 101, 110, 132, 135, 138, 144
Digital/Optical Communications 65-67, 246-255
Digitizer, Modular 144
Digitizer, Programmable 68, 72, 132, 135, 138, 144
Digitizing Signal Analyzers 68, 72
DMM 118
FFT Capability (Frequency Domain) 65-71
Handheld 110-112
Hardcopy Output *see Printers/Plotters*
HDTV 118
Logic Analyzer Based 168-182
Mainframes for Modular Plug-Ins 65-67, 85-89, 246-255
Military Designator (AN/USM-488) 97-100
Modular 336-340
Optical-to-Electrical 224, 246-255
Plug-Ins 78-84, 90-95
Portable 50, 68, 72, 85, 97-129
Printers/Plotters 414-417
Probes 223-488
Pulse Template Tester 245
Rackmount 50, 65-67, 85-89
Rackmount Kits 486-487
Ruggedized 97-100, 110-112
Sampling 65-67, 90-95, 246-255
Accessories 95
Delay Line 94
Digital 65-67, 246-255
Heads 90-93
Multi-Channel Unit 94
Software *see Software*
Storage
CRT 110-112
Digital 50, 68, 72, 86, 97, 101, 110, 132, 125, 138, 144
Equivalent-Time DSO 68, 72
Real-Time DSO 50, 68
Variable Persistence 65-67, 246-255
Telecommunications 50, 246
Television 118
Training 390, 529
Travel Accessories 488
Viewing Accessories 484
P
Passive Voltage Probes 461-467
Patch Cords 480
Pattern Generator 314-316
Photometer/Radiometer 404-406
Physical Measurement Instruments
Fourier Analyzers 68, 72, 216
Multi-Channel Analyzers 68, 762, 132, 135, 138, 144, 220
PC-Based 326
Temperature Probes 459
Plotter, Four Color 416-417
Plug-Ins 78-84, 90-95
Portable Products
Logic Analyzers 151-184
Oscilloscopes 50, 68, 72, 85, 97-129
Spectrum Analyzers 185-215
Power Dividers (SMA) 482
Power Meter, Optical 230, 240
Power Plug Options 531
Power Supplies
Modular 317-319, 388-389
Spectrum Analyzer 215
Probe 438
Pre-Certification Software 212
Pre-/Post-Certification System 211
Pre-Qualification Software 212
Preselector, RF Stepping 213
Printers
Color 506-507
Dot Matrix 414-415
Ink-Jet 506-507
Thermal, Black & White 414-415
Thermal Wax 506-507
Probes 423-483
1X-10X Switchable 462, 464
Accessories 472-483
Active (FET, Bipolar, Bias/Offset) 428-435
Adapters/Attenuators 481-483
Buffer Amplifier 440
Current 444-449
Current Amplifiers 446
Data Acquisition/Trigger 460
Differential 452
Differential Amplifier 439
Digital Photometer/Radiometer 404
Environmental 459
FET 428-435
Fixtured 440
Ground Leads 472-479
High Current 446
High Frequency 428-436
High Voltage 454
Instrument/Probe Reference Chart 424-425
Isolators 456-458
Logic Analyzer 183-184
Logic Trigger 460
Low Capacitance 428, 436
Low Impedance 436
Low Loading 428, 436
Micro 440

Functional Index

Microwave 468-471
Optical-to-Electrical Converter 226
Oscilloscope to Probe Cross Reference 424-425
Passive Voltage 461
Pattern Generator 151, 183
Power Supplies (Fixtured/Active) 439
Probe Card 440
RF 459
SMT Device Interconnects 442
Specification Chart 426
Spring Contact (Fixtured) 440
Temperature 459
Voltage
Active 428
Passive 461
Low Impedance 436
Reference Chart 424
Word Recognizer/Trigger 460
Programmable DMM 384-385
Pulse Generators 306-316
R
Rackmount Products
Cart 422
Kits 486-487
Oscilloscopes 50, 65-67, 85-89
Waveform Capture Systems 144
Radiometer/Photometer 404-406
Receivers, SDH/SONET 228
Reconditioned Instruments 528
Recorders, Chart 220
Reference Information
Attenuator Selection Guide 483
Camera Selection Chart 410
Cart Selection Guide 418
Digital Counter Selection Guide 327
Digital Multimeter Selection Guide 320
Function Generator Selection Guide 299
Instrument/Probe Chart 424-425
Logic Analyzer Selection Guide 155
Microprocessor Support Selection Guide 155
Modular Oscilloscope Selection Guide 336
Oscilloscope Calibration Selection Guide 359
Oscilloscope Reference 42-48
Oscilloscopes 51, 65, 67, 97, 101, 113
Oscilloscope to Probe Cross Reference 424-425
Modular Power Supplies Selection Guide 317
Power Plug Options 531
Pulse Generator Selection Guide 307
Self Study Programs 392
Software Chart, T&M 278
Spectrum Analyzers 186
Voltage Probe Reference Chart 416
X-Terminals 508-509
Reference Receivers, SDH/SONET 228
Rental Companies 540
Rental Program 530
Representatives 540
RF Products
Cable TV Spectrum Analyzer 504
Demodulator 504
DMM Probes 459
Spectrum Monitor 504
Sweep Transmitter 504
Sweep Receiver 504
Tunable Down Converter 504
RS-232-C Cables 480
S
Sales & Service Offices 536-539
Sampling
Accessories 95
Oscilloscopes 68, 72, 132, 135, 138, 144
Delay Line 94
Digital 65-67, 246-255
Heads 90-93
Multi-Channel Unit 94
Optical to Electrical Head 90-93, 232
Waveform Capture Systems 144
Scanners
Cards 341
Master (VXI) 268-271
ScopeMobiles 418
SDH/SONET Reference Receivers 228
Selection Guides *see Reference Information*
Self-Study Programs 392
Semiconductor Testers 18-19, 28-29, 395
ASIC Verification 166-167
Curve Tracers 395
ICs 514
Socket Adapters 403
Software 278, 399-400
Seminars 529
Serial Digital Products
Video 497
Waveform Monitor 494
Service Information 524-527
Service Oscilloscopes 110
Service Training/Seminars 529
Signal Analyzers 68, 72
Signal Conditioners 348-350
Signal Generators *see Generators*
Signal Pickoff 482
Signal Sources 286-316
Signal Switching/DUT Interfacing Products 268-271
Fixtured Probes 440
Spring Contact Probes 440
SMA
Adapters 481
Attenuators 482
Cables 480
SMT Clips 442
Software
Data Logging 278, 283
Digitizing Camera, MUX16 411
DSO Utility 283
EMI Testing 212
Modular Instrumentation 274, 282
Pass/Fail Testing 274
PC 751 Remote Display Software 502
Program Development System 274
Remote Site Monitoring 210
Signal Acquisition and Analysis 274-283
Spectrum Analyzer 209-210, 212
System 274
T&M Software Reference Chart 278
Technical Support 267, 521
Telecommunications Testing (ANSI, T1, CITT) 245
Teleservicing 279
Template Generation 245

Functional Index

Test Program Development 274, 280
Utility 209-210, 283
Spectrum Analyzer 209-210
11000 Series Oscillscopes 283
VM700A Remote Graphics 493
VM700A Backup and Remote Control 492
VM700A Remote Control 493
VXI 268-271
Waveform Generation 282
Spectrum Analyzers 185-215
Accessories 191, 192, 198, 199, 204, 208, 214, 215, 407-490
Cable TV Analyzer 205-208
Digital 68, 72
Down Converters 259
Inverter/Battery Pack 215
Low Frequency 201-204
Microwave 190-191
Microwave Comb Generator 198
Microwave Probes 468-471
Optical-to-Electrical Converter 232
PC-Based Systems 211
Portable 186-191, 193-198, 201-208
Probes, Microwave 468-471
Software 209-210, 212
Tracking Generator 200
TV Sideband Adapter 200
VHF/UHF 186, 193-198, 201-208
Waveguide Mixers 192, 199
State Analyzer 151
Stimulus Systems 269, 314-316
Synchronizers, Audio and Video 501
System Controllers
Instrument 472-473
VXI 268-271
Systems
Avionics Subsystems Test 265
Electrical Sensors Test 265
EMI Measurement 211
Open Measurement 263, 267
Optical Communications Test 266
Semiconductor Characterization 266
Standard Platforms 264

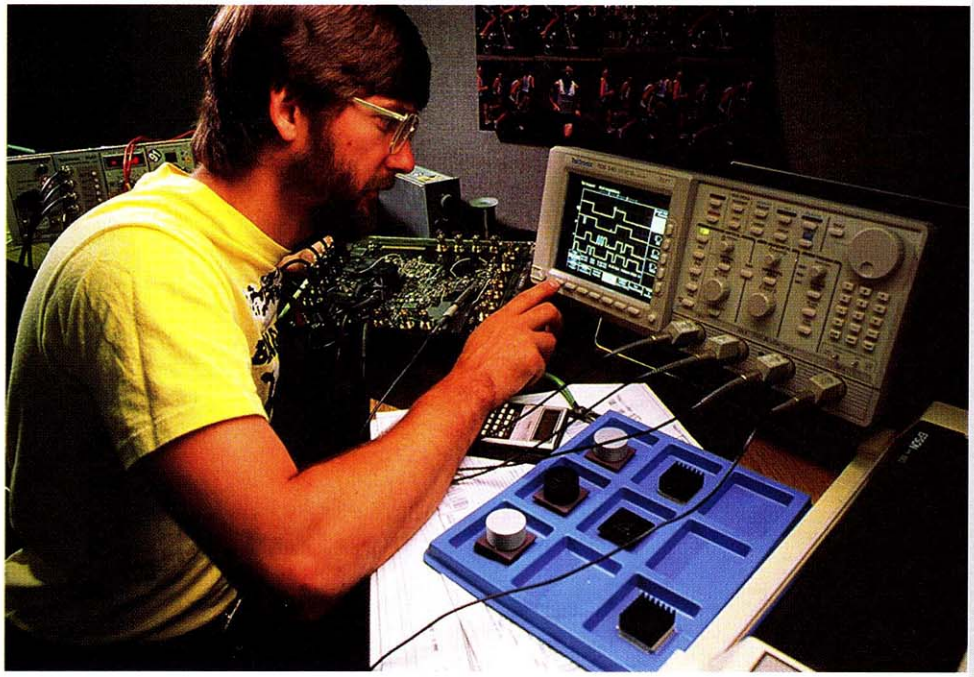
T

Technical Support 267, 521
Telecommunications Test Equipment 18-19, 22-23, 65-67, 155, 166, 185, 224-255
ASIC Verification Test 166-167
Accessories 224, 407-490
Bit Error Rate Test Set 254
Cable Testing, Optical 234, 246
Communications Signal Analyzer 65-67, 246-255
Data Communications 245
LAN Media Testing 244
Metallic Cable Testers 244
Optical Cable Testing 234
Optical Communications Test System 267, 266
Optical-to-Electrical Converters 226-233
Optical Probes 226
Probes 423
Pulse Template Testing 245
RS-232 Analyzer 155
Spectrum Analyzers 185
Waveform Analyzer 155
Television Test Equipment 491-504
Accessories 480-490
Audio Vector Converter 502
Cable TV Spectrum Analyzer 504
Decoder, NICAM 502
Demodulators 504
Encoder, NICAM 502
Modulation Monitor 502
Signal Generators 496-500, 502
Audio 502
Component 496-499
Component/Composite 499
Composite 496-499
Digital 496-498
Digital to Analog Converter 496
High Definition 499
High Definition Sync 499
Generator/Inserter 498
Insertion 498
Multiformat 497
Pattern 500
Programmable 500
NTSC 496-500
PAL 496-500
Serial Digital Video Interface 496
SVHS/PAL 497
YC/NTSC 497
Spectrum Monitor 504
Stereo Audio Monitors 503
Sweep Receiver 504
Sweep Transmitter 504
Synchronizers 501
Audio 501
Video 501
Tunable Down Converter 504
Vectorscopes With Polar SCH Phase Display 494-495
Video Measurement Sets 492-493
Waveform Monitors 494-495
Analog Composite 495
Component/Composite 495
Multiformat 495
Serial Digital 494
Temperature Probes 459
Terminals, Graphics 508-509
Terms of Sale 530
Test Leads 480
Test & Measurement Instruments *see Modular Instruments*
Test & Measurement Software *see Software*
Test System
Avionics Subsystems Test 265
ASIC Verification 166-167
Electrical Sensorts Test 265
EMI Measurement 211
FDDI Physical Layer 266
Open Measurement 263, 267
Optical Communications Test 266
SDH/SONET Physical Layer 266
Semiconductor Characterization 266
Standard Platforms 264
Thermal Wax Printers 506-507

Functional Index

Time Domain Reflectometry (TDR) Systems
Metallic TDRs....244
Optical TDRs....234, 236, 243
Oscilloscope....65-67, 246-255
Probes
Low Frequency....436
Microwave....468
Time Interval to Voltage Converter....450
Time Mark Generator....363
Timing Analyzer....151, 450
Tracking Generator For Spectrum Analyzers....200
Training/Seminars....529
Transient Digitizers/Recorders....68, 132, 135, 138, 144
Travel Accessories....488
V
Vectorscopes....494-495
Video Copiers....414-415
Video Display Drivers....513
Video Measurement Sets....492-493
Video Monitor....411
VITS/ITS Inserter....498
VME Conversion Module (VXI)....268-271
Digitizers....144
Waveform....144
Voltage/Probe Reference Chart....424-425
VXI
Arbitrary Waveform Generator....269
C-Size VXI....268
Controller....268
Counter/Timer....269
D-Size VXI....268
Development Modules....268
Digital Analog Converter....269
Digital Input/Analog Comparator....269
Digital Multimeter....268
Digitizer....269
Function Generator....269
Mainframes....268
Power Meter....269
Relay Drivers....270
Scanners
Master
CDS....270
VXI....270
Slave
CDS....270
VXI....270
Serial Pattern Generator....269
Stimulus Instruments....269
Switches
CDS....270
VXI....270
Switch Matrix....270
System Controllers....268
Systems....268-271
Thermocouple Measurement....269
Waveform Analyzer....269
W
Warranty Information....522-523
Warranty-Plus....524
Waveform Digitizers....68, 72, 132, 135, 138, 144, 220
Waveform Monitors....494-495
Waveguide Mixers....192, 199
Word Generator & Acquisition Card....151
Word Recognizer/Trigger Probes....460
Workstation, Carts....515
X
X Terminals....508

Applications Examples and Solutions



CONTENTS

TYPICAL APPLICATIONS
Product Matrix....18-19

APPLICATIONS AND CASE STUDIES
Avionics....20-21
Telecommunications....22-23
Education....24-25
Industry....26-27
Semiconductor....28-29

NEW PRODUCTS....30-40

Applications Examples and Solutions

Tektronix' goal is to offer products and services that aid your productivity and add value to your business. Tektronix tools exist to serve your application needs. This section shows you some of our products at work, then introduces our latest generation of instruments, systems, and accessories. Read on to see how Tektronix can help you achieve your own application goals.

Recommended Solutions

	R&D	DESIGN
AVIONICS		
• Mfg. Test • Depot Test • Flightline test • Maintenance • Product Development	**Typical App: On-Board Nav. & Comm.** 2794 Spectrum Analyzer TR 503 Tracking Generator TDS 820 Digitizing Scope	**Typical App: Rad-Hard Design Evaluation** VX1500 VXI Mainframe VX5521 VXI Slot 0 Resource Module VX5790 Arbitrary Waveform Generator VX5260A Digitizer RTD710A Waveform Digitizer
TELECOMMUNICATIONS		
• Eye Pattern Analysis • Optical Waveform Analysis • Bit Error Rate Test • SDH/SONET, FDDI Test • Cable Test (TDR) • ISDN Field Test	**Typical App: Physical Layer Stds. Development** CSA 803 Communications Signal Analyzer i-Pattern Software CSA 907A Bit Error Rate Test Set OCP 5002 O/E Converter/Power Meter 2784 Spectrum Analyzer	**Typical App: Optical Transceiver Compliance Test** CSA 803 Communications Signal Analyzer ORS Series SDH/SONET Reference Receiver CSA 907A Bit Error Rate Test Set OA 5000 Optical Attenuator OIG 502 Optical Impulse Generator 2784 Spectrum Analyzer
EDUCATION		
• University R&D • EE Design Classroom • Test Eng. Classroom • Service Tech. Training	**Typical App: University R&D** DAS 9200 Digital Analysis System TDS 820 Digital Storage Scope HFS 9009 Data Time Generator RTD 720 Transient Event digitizer 2520 TestLab Acquisition Station	**Typical App: EE Degree Program** TDS 460 or 540 Digitizing Scope 371A Curve Tracer 2756 Spectrum Analyzer 2642 Fourier Analyzer 3001 GPX Logic Analyzer
INDUSTRY		
• Electronic Service • Power Measurements • System Diagnostics • Frequency Analysis • Environmental Test	**Typical App: Vibration/Modal Analysis** 2600MS Modal Analysis Solution STARMODAL Software TekSTAR Acquisition Manager Software RIC 386 or PC compatible controller	**Typical App: Power Control Circuit Design** DSA 602A Digitizing Signal Analyzer 11A33 Differential Amplifier 11A16 Current Probe Amplifier AM 503S Current Probe System
SEMICONDUCTOR		
• Device Characterization • DC Parametrics • Design Verification • At-Speed Test	**Typical App: Device Research** 11801A Sampling Scope HFS 9000 Data Time Generator 372 Semiconductor Workbench DSA 602A TMP 9000 Microprobes PS5010 Power Supply	**Typical App: Design Verification** OME 1300/2300 Semiconductor System (includes 11801A, HFS 9000, LabVIEW software) LV500 ASIC Verification System 370A Curve Tracer PS5010 Power Supply TDS 820 Digitizing Scope

MANUFACTURING TEST	SERVICE
Typical App: Mfg. & Depot Test OME 1200/2200 Avionics Test System (includes VX4236 DMM, VX4286 Comparator, 73A-308 Discrete Output, VX4386 Matrix Switch, VX4355 Relay Switch, EPC7 Controller, Power Supply (-32V), LabVIEW software) VX4469 ARINC 629 Bus Tester 73A-455 MIL-STD-1553 Simulator Tester	**Typical App: Flightline Maintenance** 222A Handheld Scope TM 5006A Mainframe DC 5010 Counter/Timer DM 5120 DMM AWG 5105 Arbitrary Waveform Generator
Typical App: Functional Board Test OME 1400/2400 Optical Communication Standards Test System (includes CSA 803, CSA 907A, Controller, LabVIEW software)	**Typical App: Cable Restoration** 1502C Metallic Cable Tester/TDR TFP2 FiberMaster Optical TDR TFS2020 FiberScout Optical Fault Finder TFC200 FiberChamp Optical Power Meter
Typical App: BSET Degree Program OME 1000/2000 System (includes mainframe, controller, LabVIEW software) VXI modules (digitizers, signal sources, etc.) TM5000 Modular Instruments 1230 Logic Analyzer 2467B or TAS 465 Scope	**Typical App: Technician Training** 224 Handheld Scope 2225 Benchtop Scope TM250 Basic Bench Set (includes Power Supply, DMM, Function Generator)
Typical App: Disk Drive Test 2630 Personal Fourier Analyzer DSA 602A Digitizing Signal Analyzer 11A33 Differential Amplifier 11A16 Current Probe Amplifier AM 502 Comparator P6046 Differential Probe TVC 501 Time-to Voltage Converter	**Typical App: Field Service** 222A Handheld Scope 222 PowerScout Power Meter CATS Software DM 2510 Multimeter
Typical App: At-Speed Test 11801A Sampling Scope 11403A Digital Storage Scope HFS 9000 Data Time Generator PS5010 Power Supply	**Typical App: Failure Analysis** 372 Semiconductor Workbench TDS 820 Digitizing Scope PS5010 Power Supply

This matrix illustrates some recommended solutions to common test and measurement problems. While the list is not all-inclusive, it conveys a message: Tektronix is equipped to solve your test and measurement problem, no matter what your application. These recommendations are just some of the ways that your test and measurement needs can be handled. For other examples, read the ten-page applications section that follows this matrix to see how Tektronix has helped its customers to find just the right solution for some difficult measurement challenges.

For more information on fulfilling your particular test and measurement requirements, contact your nearest Tektronix sales office, or in the U.S. call 1-800-426-2200, Extension 99.

Avionics

From the Factory to the Flightline

Avionics testing can mean flightline troubleshooting with a handheld scope, depot-level maintenance with benchtop instruments, or factory production QC with a computer-controlled VXI system. Avionics test requirements range from bus testing of ARINC and MIL-STD-1553-based subsystems to continuity testing of fiber-optic and copper interconnect systems.

Test instruments are tasked with a range of responsibilities: line-replaceable unit (LRU) functional testing, flightline testing, engine, process, and satellite monitoring, and RF and microwave testing. Each of these areas is of course characterized by stringent requirements for quality control.

Tektronix offers solutions to meet each type of test requirement. For LRU and SRU functional testing, the prescribed solution is an automated test system capable of providing a wide range of stimulus signals, including ARINC and MIL-STD-1553 bus signals. The VX4469, 73A-425, and 73A-455 are some of Tektronix' dedicated VXI functional test modules for these busses. Typically one or more such bus modules will be integrated with appropriate digitizers, DMMs, and switching modules, plus a UUT interface. The ancillary modules might be used, for example, to verify an aircraft's self-test systems by simulating aircraft malfunction signals.

Engine and process monitoring requirements, while not technically the same as "testing", nevertheless are served by Tek's VXI waveform analyzers, A/D and D/A converters, DMMs, and Power Meter modules, as well as GPIB-based scopes in the TDS 500, 600, and 800 families.

Avionics RF and microwave testing requirements are served by Tek's broad line of spectrum analyzers and telecom test equipment. GPIB instruments such as the 2790 Spectrum Analyzer or the CSA 404 Communications Signal Analyzer can be integrated with VXI components under the control of a single embedded controller to form a comprehensive factory- or depot-level test system.

Flightline maintenance tasks demand compactness as well as performance, and the Tektronix 222A Handheld Oscilloscope is ideal for the job. In addition, Tek offers ruggedized configurations of many of its scopes and spectrum analyzers.

Avionics measurements are made at the flightline, the depot, and the factory.

Avionics

CASE STUDY

A major aerospace manufacturer in the Southwestern U.S. was faced with the ongoing task of performing final testing on wiring harnesses in military aircraft manufactured at the site. Although the harnesses were tested in their own fabrication department after assembly, they required a second round of testing after installation to ensure that they were not damaged in that process.

The existing test methodology was carried out by an aggregation of monolithic instruments permanently installed in a massive "mobile" cart. This architecture had proven to be inflexible, hard to maintain, and complex to operate. Moreover, some of the instrumentation was obsolescent.

In addition, the control software lacked the access privilege protocols needed to guarantee the security of the test programs. The goal was to implement two levels of access, one for the test engineer and one for the operator. The operator would be locked out of the test program code, and would only have access to the run-time procedure.

The customer came to Tektronix to find a solution that offered improved efficiency as well as the reconfigurability needed to cope with evolving test needs. After consultation, it was decided that VXI was the most appropriate architecture due to its higher throughput (vs. discrete instrument systems) and the ease with which it can be upgraded or reconfigured.

The system delivered to the customer was a combination of VXI-based switching and DMM modules installed within a single VXI mainframe. The switching modules multiplex the many conductors in the harness to the DMM input for continuity checking. An embedded controller coupled to a touchscreen provides the compute power to run the tests as well as administer the security protocols.

A VXI-based test system rack similar to that included in this OME-2200-00 Avionics Test System provided higher throughput and solved a harness testing problem.

The customer chose to use a mixture of VXI components from Tektronix and another vendor. Tek's open system architecture permitted all of these modules to work together with uncompromised functionality.

The new VXI system has streamlined the customer's the testing process. Test times are shorter than with the previous discrete instrument system, and the mobile cart is far smaller, lighter, and more easily moved from aircraft to aircraft within the manufacturing hangar. Should the testing mission or the Unit Under Test (in this case, the wiring harness) change, the system stands ready to be reconfigured with the simple replacement of plug-in modules.

Telecommunications

Automating Field & Factory Measurements

Telecommunications (telecom) measurements fall into two general areas: those used in research, design, and manufacturing of high-speed communications equipment; and those related to installation and operation of network transmission equipment.

Telecom equipment manufacturers must test ever more products as they rush to meet the burgeoning demand caused by the adoption of interface standards for telecom equipment. The standards ensure that equipment from different suppliers will integrate and work properly when joined. The SDH/SONET (Synchronous Digital Hierarchy/ Synchronous Optical Network) and FDDI (Fiber Distributed Data Interface) standards, for example, mandate compliance tests for bit error rate, mask/pulse templates, and optical waveform analysis as well as the integrity of the transmission medium (electrical or optical).

The Tektronix CSA 803 communications signal analyzer is the preferred tool for standards compliance testing: it offers built-in eye-pattern and mask testing, plus high sample rate and resolution. Tek's new SDH/SONET Optical Reference Receivers (the ORS Series) are an integral component of eye pattern testing of SDH/SONET rates from 51.84 Mbit/s to 2.488 Gbit/s.

For bit error rate testing, the CSA 907A Bit Error Rate Test Set is used to generate and analyze the integrity of a digital bit stream. Its repertoire of fully automated measurements includes bit error rate, totalized errors, error free seconds, and others. It provides both stimulus and acquisition, and its ability to automatically synchronize on a data pattern reduces setup time.

Installing and maintaining transmission equipment can present an entirely different set of test problems. Servicing metallic and fiber optic cable, for instance, requires high-performance time-domain reflectometry techniques. This is by far the most expedient way to locate cable faults and discontinuities quickly.

For metallic cable testing, Tektronix offers the 1502 and 1503 Metallic TDRs. These are suitable for uses as diverse as locating shorts and opens, or pinpointing wet sections of cable. Their high resolution also makes them ideal for LAN testing or analyzing critical wiring systems aboard ships or aircraft.

Tek's fiber optic cable testers are the industry standard OTDRs for the purpose. The TFP2 FiberMaster, for instance, allows dual-wavelength single and multimode testing at the touch of a button. It provides a minutely detailed and accurate picture of cable conditions to a distance of 100 km. The TFS2020 FiberScout is built around a unique symbolic display that provides a fast, easy-to-understand test methodology for optical cable restoration.

Fiber-optic cable measurements ensure signal quality and system integrity.

Telecommunications

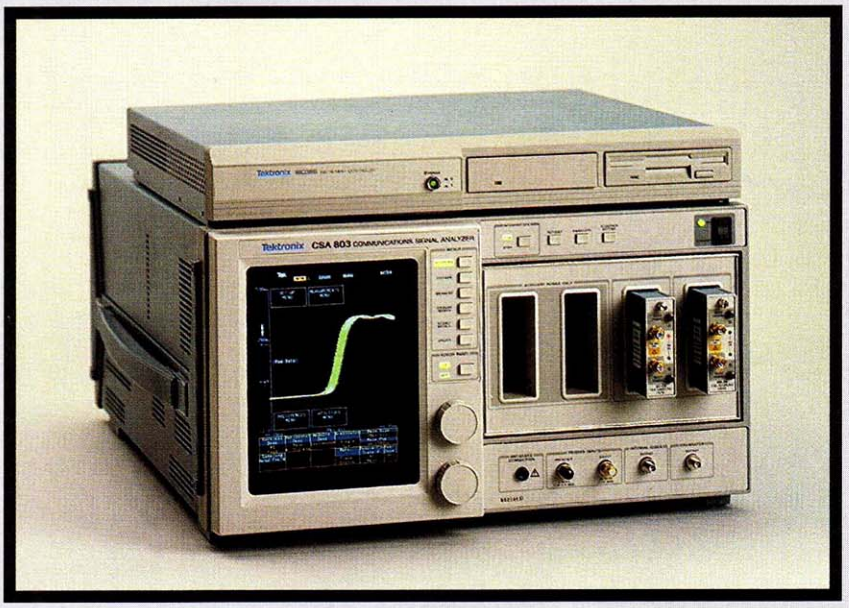
CASE STUDY

The customer, one of the world's largest telecommunications equipment and service suppliers, was faced with the problem of ensuring that its fiber-optic network products complied with SDH/SONET standards. Such compliance is the one guarantee that network equipment from one vendor will work with that of another.

The testing challenge was to find a solution that provided both quantity and quality. Thousands of network element interfaces having four different transmission rates had to be tested in both the design and the production phase. The throughput of the test system would have a direct impact on the cost of salable units produced. Qualitatively, compliance testing in this case means ensuring that the equipment is within worst-case tolerances for a "mid-span meet." This is defined as the point midway between two central offices (transmission sources). Here, most distant from their origin, network signals potentially exhibit the most loss and aberrations.

The application demanded an automated means of running the "eye-diagram" comparisons that reveal noise, loss, and bandwidth problems in fiber-optic network circuits. These are so called because the displayed waveform looks somewhat like a flattened hexagon or oval, resembling an eye. This "eye" is compared against an ideal waveform image – a "mask" during the test. Formerly the ideal image was actually hand-drawn on the test instrument CRT and visually compared. Clearly, this was not a satisfactory solution in a mass production environment.

The customer selected the Tektronix CSA803 Communications Signal Analyzer coupled with a calibrated set of ORS SDH/SONET reference receivers. The CSA803 is a 40 GHz digital storage oscilloscope that provides automated eye-pattern mask testing plus a full range of related measurements, such as jitter, extinction ratio, and pulse rise/fall time. Masks are store in the instrument's memory. This instrument is specifically designed for telecom testing applications, and uses Tek's i-pattern™ test automation software package to further optimize it for high-volume production testing.



The CSA803 automated complex "eye-diagram" functional tests. Also shown; RIC 386 instrument controller.

The ORS reference receivers are essential to the application as well. They consist of an O/E converter mated to a calibrated, matching electrical filter. This calibrated pairing minimizes measurement system effects on the signal, ensuring that during testing, a "pass" is truly a pass.

The test system is now in place. It has provided great gains in throughput and its accuracy and repeatability have allowed for reduced margins, improving yield. In addition, the CSA803's built-in statistical database is providing important data for process and test methodology improvements.

Education

Serving Research and the Classroom

Educational applications for instrumentation fall into two distinct categories: research and classroom training. The university research lab needs the most advanced measurement tools available, instruments that can look into the subatomic realm, or keep pace with the fastest transient events, or acquire and analyze huge volumes of data. Conversely, the vocational classroom needs more basic instruments that give the student hands-on experience with professional-quality tools. Both situations, research and classroom, have stringent budget requirements that play a role in every instrument purchase.

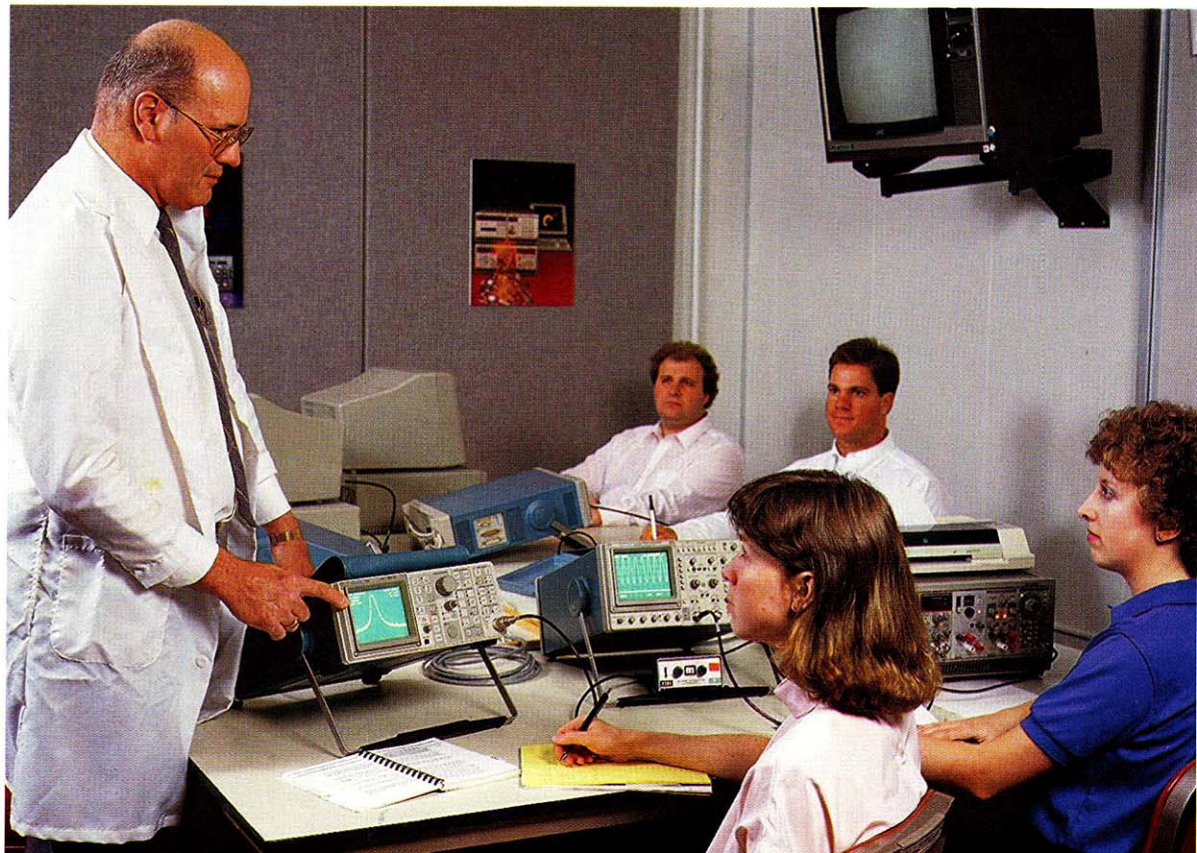
Tektronix' advanced instruments are a cornerstone of many university research programs. The TDS digital storage oscilloscopes, particularly the TDS 560, 640, and 820 models, are used for research in semiconductors, fiber optics, energy, metallurgy, medicine, and many other applications. Tek's digital measurement tools find extensive use in computer research, data communications, data compression, and pattern recognition. The DAS 9200 is a key tool for examining computer bus architectures, for example, while the CSA907 Bit Error Rate Tester helps researchers analyze fiber-optic communications networks and signals.

Instruments in the engineering classroom or vocational school have a different mission from those in research. Today's classroom experiment with a microprocessor board and a basic logic analyzer must prepare the student for tomorrow's design project with a mainframe computer and a digital analysis system. Today's TV repair lesson with a 50 MHz scope should lead to tomorrow's job maintaining radar systems with a multi-GHz spectrum analyzer. In short, students must become prepared to handle salaried positions in industry as designers, test engineers, or technicians.Tektronix offers a broad line of tools suitable for classroom applications. They offer the value essential for budget-constrained school programs, yet they provide same professional-level performance of the tools the student will encounter in the workplace. The 2467B, TAS465, and TDS 460 oscilloscopes for example, are uncompromised wideband scopes that will acquaint the user with basic measurement principles and oscilloscope operation. The 2205 and 2225 oscilloscopes are low-cost models ideal for basic scope familiarization. The 3001GPX and 1230 logic analyzers are cost-effective models that mirror the capabilities of the full-scale DAS9200 digital analysis systems used throughout industry. And the LV500 ASIC verification system and 371A curve tracer are in fact the same tools that semiconductor design students will use on the job.

Test engineering schooling implies systems training, and Tektronix provides GPIB and modular TM5000 programmable instruments as well as industry-standard VXI technology. On the software side, Tek provides the TekTMS application development software package, an easily-learned test system tool that helps the student understand system interactions and test strategy.

Service technicians in training often use the same portable measurement tools they will use on the job. Tek's TM500 and DM250 products are examples of this. These lines include meters, counters, waveform and pulse generators, and power supplies, and are in widespread use in the "real world" as well as in vocational schools everywhere. The 222A and 224 handheld oscilloscopes are also mainstays of both training programs and service departments around the world.

Measurement skills are best learned on professional-quality instruments.



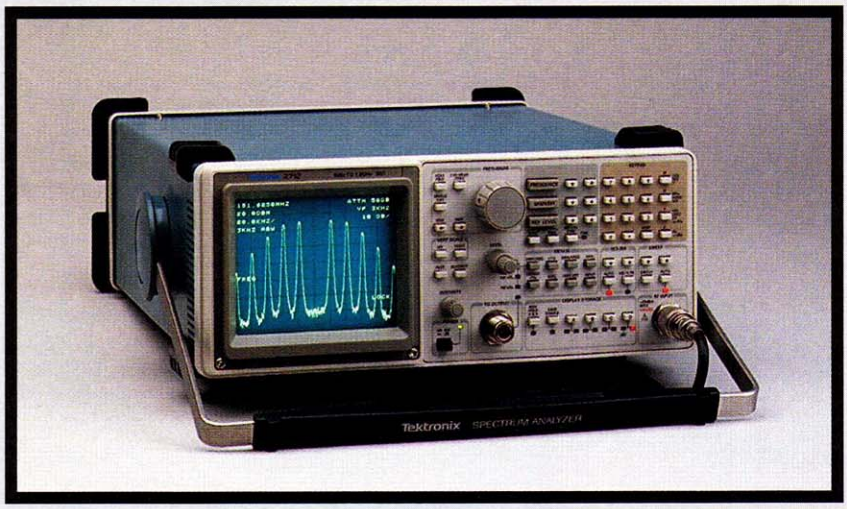
Education

CASE STUDY

A large university campus in the western U.S. planned a new research and classroom facility to study EMI (electromagnetic interference) and EMC (electromagnetic compatibility) issues. In addition to the purely educational agenda, the school also wanted to become the leading technical resource for microwave technology in its community. The project was viewed as an investment in the future. A fully-equipped university EMI facility would attract student and faculty talent, and would be a focal point to attract community participation, which would in turn give students more relevant "hands-on" experience in real-world applications.

The measurement application called for specialized tools that would permit students to acquire EMI radiation and view its spectral content. A course in "EMC for Engineering" was being developed, and the laboratory had to be stocked with instruments that could be used to teach RF measurement techniques and for sophisticated research work. Because the curriculum was aimed at advanced classes and senior projects, the field was open to products ranging from entry-level models to powerful and feature-laden instruments. Cost was of course a consideration, as was the instrument's reputation in industry. The core instrument, it was decided, would be a proven spectrum analyzer product that offered a balance of features, bandwidth, and cost-effectiveness.

The customer came to Tektronix with a menu of requirements that included mid- and high-end spectrum analyzers, EMC software, and wideband oscilloscopes. At the heart of the EMC for Engineering program is Tek's 2712 spectrum analyzer, known for its ease of use and its wealth of EMC-related features. Optioned with a quasi-peak detector, tracking generator, a field site package (power invertor and battery pack), and an antenna group, the instrument is ready to perform the full slate of FCC-mandated radiated emission tests. Thanks to the 2712's affordable price, the university was able to acquire enough units to allow the engineering classes to break up into small groups that provide plenty of hands-on work with the instruments and the EMC testing regime.



The 2712 spectrum analyzer is at the heart of the university's EMC for Engineering program.

To supplement the capabilities of the 2712s, the university selected the powerful Tektronix 2782 spectrum analyzer and the TDS 520 digital storage oscilloscope. With the 2782, students can view signals to 33 GHz. The bandwidth combination of the 2712 and the 2782 covers the majority of potential applications envisioned for the engineering course, including filter characterization and general microwave studies as well EMC exercises. The TDS 520 oscilloscope will help students understand how the waveform characteristics of the unit under test relate to its EMI emissions.

The EMC for Engineering course is set up and scheduled to begin during the 1992-1993 school year. In addition, the university has reached an agreement with a local electronic equipment manufacturer to conduct EMI/EMC testing for products in development, which will bring additional funding to the school. The school has also bid on other research contracts in its community and the region.

Industry

Ensuring Quality, Safety, and Compliance in Industrial Products

Industrial measurements encompass a varied set of applications. Factory automation, energy conservation, environmental regulation, quality improvement, and productivity issues necessitate a broad set of test instrument solutions, some general-purpose, others more application specific. Tektronix serves its industrial customers with test solutions in the areas of electronic service, power measurement, system diagnostics, frequency analysis and environmental measurement.

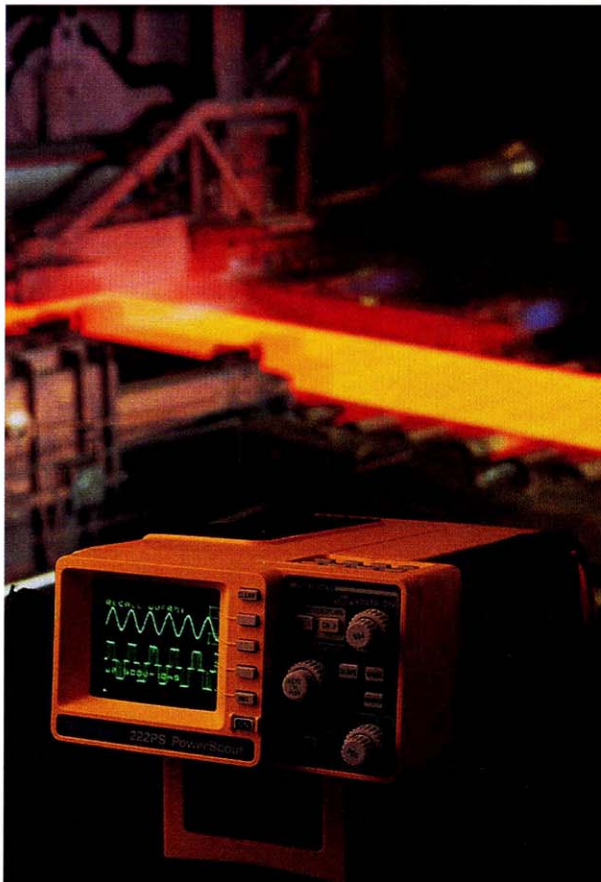
Electronic service applications include field service, electronic repair, plant maintenance and vehicle diagnostics. Tek's line of handheld and portable oscilloscopes along with a wide selection of meters, counters, generators and accessories meet the needs of most service problems. The unique 222A, 224 and 222PS handheld oscilloscopes are standard tools for any repair technician.

Power measurements involve signal conversions, monitoring of supply voltage quality, and metering of energy consumption. Instruments must measure currents, losses, component performance, and high voltages with safety and precision. Among Tek's tools for such measurements are are the AM503S/A6302 current probe and amplifier system, P6015A high voltage probe, P6046 differential probe, TVC501 time-to-voltage converter and the 222PS high voltage isolated handheld scope.

System diagnostics in the automated factory environment involve data acquisition, recording, analysis, and presentation. The Tektronix 2500 Series TestLab combines multichannel acquisition, digital signal processing and measurement management in a self-contained analyzer system that supplants manual methods of data analysis. Tektronix oscilloscopes (e.g. the TDS 400 and 500 families) provide the resolution needed to make definitive measurements on the sensors and transducers found in automated factory equipment. For ongoing process monitoring, Tek's line of VXI instruments includes a variety of acquisition and metering tools for computer-controlled applications.

Frequency analysis is used for mechanical, electromechanical and electronic systems that exhibit vibration, oscillation and energy transfer characteristics. Tektronix frequency analyzing equipment ranges from Fourier analyzers to the DSA Digital Signal Analyzer, the TDS scopes and the 2700 series RF/Microwave spectrum analyzers. The 2600 Series Fourier analyzers work with PC-based measurement and interface programs to test products as diverse as disk drives and transmissions.

Environmental measurements relate to both ergonomics and regulatory compliance. The Tektronix J17 Radiometer is especially useful for measuring light levels, a key human factor in the workplace. It easily handles specific light measurement problems like chromaticity, luminance, illuminance, radiance and irradiance. And Tektronix spectrum analyzers are widely used to evaluate electronic products for EMI compliance.



Industrial measurements look at power, temperature, acceleration, vibration, and more.

Industry

CASE STUDY

A leading manufacturer of brake equipment for the rail and mass transit industries sought a more efficient means of testing its new products and product improvements. The company's goal is to make certain that its pneumatic braking systems for railroad cars are as safe and reliable as humanly possible. To do so, it runs comprehensive full-scale field tests, including a braking test under actual operating conditions – a freight train 2-1/2 kilometers in length stopping from a speed of 100 KPH at a test site in the remote Nevada desert. During these tests, engineers measure and record such forces as hydraulic and pneumatic pressures, linear motion, RPM, temperature, pressure differentials, and mechanical force, as well as various electronic system responses.

The biggest test problem was simply gathering and correlating the vast amounts of data that accumulated as the ponderous train came to a stop over a period of more than a minute. In previous tests, this data had been recorded with a collection of analog gauges, plotters, stopwatches, and chart and tape recorders, all working in conjunction with a mainframe computer. The system was not portable, meaning that field data had to be taken to a lab for full analysis, and measurements were sometimes not repeatable. Moreover, the test results were difficult to correlate – to view the "big picture" of all the various data curves as they evolved through time.

The customer searched the instrumentation market for a suitable tool and ultimately came to Tektronix for the 2510 TestLab, Tektronix' a self-contained multi-channel data acquisition, display, analysis, and storage system. The TestLab is connected to a signal conditioning system and in turn to a network of sensors and transducers aboard the train. Measurements are taken simultaneously at the front and rear of the train, commencing with a trigger signal generated at the instant the brakes are applied. The Tek instrument receives these measurements and gets down to the task of "number crunching:" it accumulates 256K data points per test on each of its four data channels of data concurrently. Then it performs instantaneous analysis of that information. All the figures are interactively annotated. The data curves for both ends of the train are plotted on a single display for ease in viewing the relationships of the forces that occur during braking.

The 2510 TestLab, shown at right in this photo above, provided the number-crunching power needed to analyze volumes of sensor data during rail train braking tests.

The Tektronix 2510 TestLab has eliminated the need for the manual hardcopy analysis and correlation that formerly took up costly engineering resources, and has greatly improved the overall accuracy of the testing regime. The customer plans to begin testing its brake products for mass transit cars shortly, and will take advantage of the Testlab's expandable architecture (increasing the capacity to a total of 12 channels) to test these more complex systems.

Semiconductors

Solving the Most Challenging Device Characterization Problems

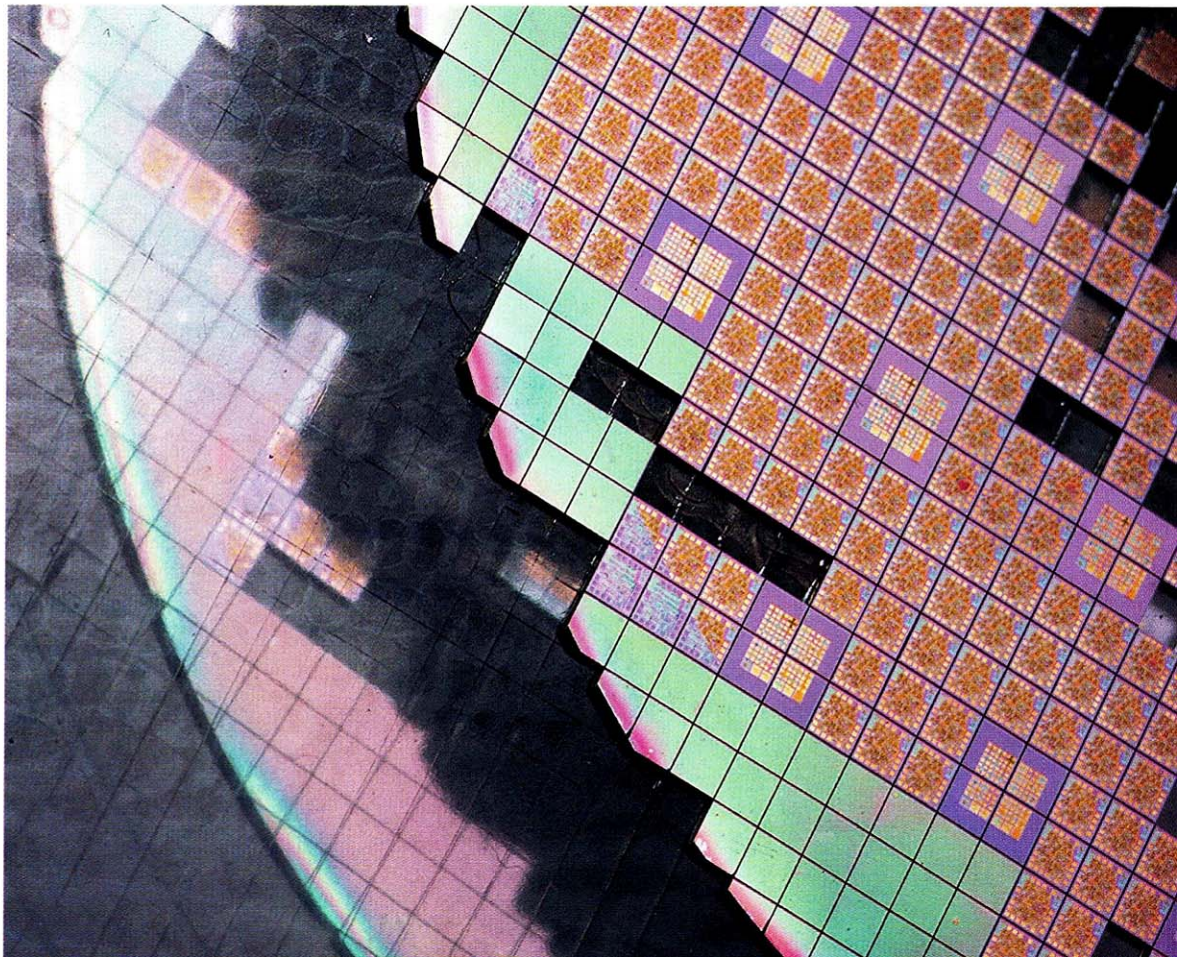
The semiconductor industry demands the most advanced tools and services from its suppliers in order to stay at the leading edge of technology. Tektronix meets these demands with products and services ranging from characterization systems and measurement instruments to high performance IC foundry capabability. For semiconductor designers and engineers, these solutions increase productivity, shorten time to market, and expand the capabilities of limited engineering resources.

Tektronix solutions are aimed at important phases of product development: design verification, IC characterization, and at-speed test. These phases require a lot from measurement equipment and software: intuitive operation, a wide range of capabilities, repeatable accurate measurements, and the highest performance available. Tektronix products meet these needs.

Available solutions range from complete systems for digital IC timing characterization (OME 1300/2300 series), to stimulus and acquisition intruments (HFS 9003 Data Time Generator, 11801A Digital Sampling Oscilloscope), to parameter analyzer and curve tracers (372 Semiconductor Workbench, 370A and 371A Curve Tracers), to microwave probes for connection of signals directly to wafers under test (TMP 9000).

If you need to measure DC parameters for IC process development or monitoring, characterize AC performance for limits specification, measure interconnect impedance for design verification, or test ICs at rated speed, a Tektronix tool will help you do the job more accurately and efficiently.

Semiconductor measurements occur at the wafer and the package level.



Semiconductors

CASE STUDY

The customer, a California-based semiconductor manufacturer known as an innovator in IC technology, wanted to update the discrete instrument-based device characterization systems in use at its Eastern U.S. design and manufacturing facility. The systems were at the heart of the site's product engineering effort. They were used to generate publishable data sheet specifications. Each of these existing systems consisted of a cluster of pulse generators, data generators, static logic level sources, and a switch matrix. Operating the systems was cumbersome, time-consuming, and the necessary re-cabling and "tweaking" for each type of DUT (Device Under Test) made the measurement procedure prone to error and inconsistency. The customer needed a more compact solution that integrated the critical hardware functions, improved repeatability, and was easier to use.

Various monolithic automated semiconductor test systems were evaluated and found to be far too expensive for the purpose. The application called for an up-to-date, integrated solution comparable in cost and scale to the existing system, with features optimized for semiconductor characterization needs.

To solve the problem cost-effectively, the customer selected two components from Tektronix: the HFS 9000 Data Time Generator and the 11801A Digital Sampling Oscilloscope. Together, these units provide stimulus and acquisition for a wide range of digital device characterization requirements. The HFS 9000 replaces a whole rack of pulse generators, level sources, data generators, and the switching matrix as well. Importantly, it provides the channel count needed for complex IC evaluation: it can be configured with up to 36 output channels. This means plenty of signal sources for DUTs with 24- and 32-bit registers, and, thanks to the HFS 9000's system-wide common clock source, the timing accuracy and skew of all of these channels is far better than that achieved with discrete generators.

The HFS9000 and the 11801A replaced a rack full of instruments.

The 11801A works hand-in-hand with the HFS 9000 to complete the test solution. Its 0.01 ps timing resolution allows the instrument to very accurately make risetime, setup and hold time, propagation delay, and other vital device timing measurements. This is critically important because the data sheet specs and production test guardbands for the company's products are based on the characterization system's results. A minute inaccuracy in defining, say, the propagation delay of a device's inputs can degrade the selling price of thousands of parts.

The Tektronix HFS 9000/11801A system is in constant use at the customer's facility for a variety of characterization measurements, including crosstalk, metastability, Fmax, setup & hold, minimum pulse width, ground bounce, propagation delay, and more. It has greatly improved productivity for the task, freeing up engineering resources and reducing testing costs.

New Products

This catalog presents one of the broadest selections of electronic instrumentation available from any source. Let Tektronix work with you to find a solution to your test and measurement challenges.

As your test and measurement needs evolve, so do Tektronix products. This new product section highlights some of Tektronix' major new entries in oscilloscopes, logic analyzers, spectrum analyzers, telecommunications products, accessories, and other areas. And there are more – you'll find new products, accessories, and enhancements everywhere in this catalog.

Of course, every product must fulfill a real application need, and that's exactly what all the products, new or existing, in this catalog are all about. Tektronix is committed to providing the right tool for your application, whether it's laboratory measurements at the "edge of the envelope" or field troubleshooting of telephone circuits. Talk to Tektronix – you'll find solutions for your most challenging test and measurement needs.

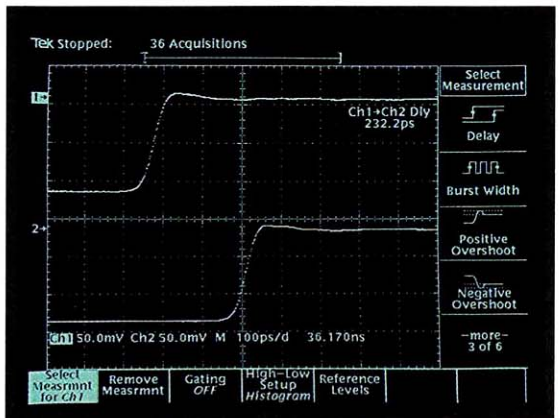
The TDS 800 Series brings the innovative TDS platform into the multi-GHz realm. Pace-setting performance makes the TDS 800 models ideal for semiconductor characterization and telecommunications applications.

See Oscilloscope Section on pages 41 to 130.

TDS 800 Series Oscilloscopes

The TDS 800 Series display offers infinite and variable persistence as well as electronic mask drawing and display.

See Oscilloscope Section on pages 41 to 130.

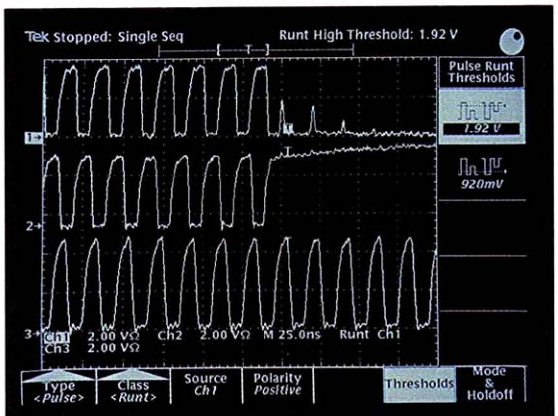


TDS 800 Series

Oscilloscopes

The TDS 640 with 2 GS/s sampling on four channels, provides a wealth of triggering options: glitch, runt pulse, pattern, state triggering, and more. A powerful tool for digital design, it will help you find the race conditions and transients that "bug" your digital circuits.

See Oscilloscope Section on pages 41 to 130.



TDS 600 Series Oscilloscopes

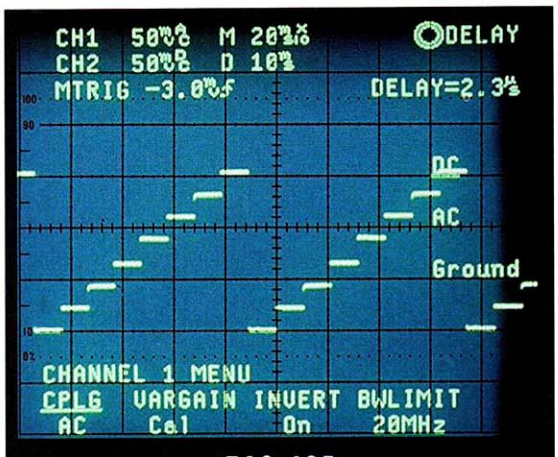
Tektronix' TDS and TAS lead the industry in advances in the state of oscillography. TAS menus and waveform displays run concurrently, making it easy to select and manipulate your display.

See Oscilloscope Section on pages 41 to 130.

TAS Series Oscilloscopes

The two-channel TAS 465 analog oscilloscope streamlines measurement procedures with its intuitive, TDS-style user interface and 100 MHz bandwidth.

See Oscilloscope Section on pages 41 to 130.



TAS 465

These new products are only the latest examples of Tektronix' continued advancement of the state of test and measurement technology. Listed below each entry are page references for the catalog section that features that respective type of instrument. There you'll find more detail on the new products as well as selection guides, tutorials, and pricing information on new and existing products.

Oscilloscopes

Tektronix offers a range of scopes and related products unmatched in the industry. Whether you're looking for economical classroom models or high-end laboratory scopes, Tektronix can provide you with the most powerful, cost-effective solution available.

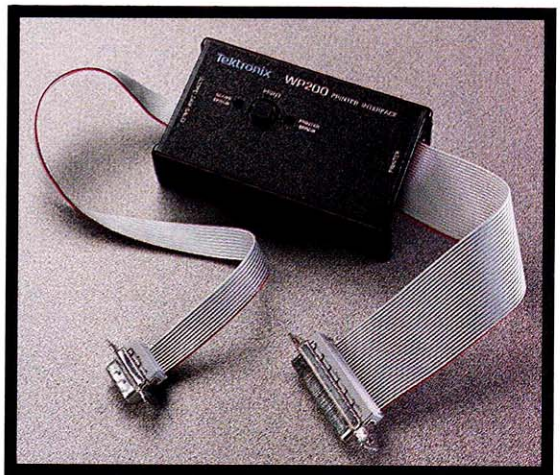
The 220 family of scopes provides unsurpassed power in the world of handheld oscilloscopes. The 222A and 224 have a 10 MHz bandwidth, and 10 MS/s digitizing rate. Battery operation eliminates the need for external power.

See Oscilloscope Section on pages 41 to 130.

220 Handheld Oscilloscopes

The WP200 parallel printer interface provides an easy means of recording waveforms from the Tektronix 220 family of handheld oscilloscopes. It connects directly to the printer cable; no computer or software is required. It's battery operated and compatible with a wide variety of Epson FX and similar printers.

See Oscilloscope Section on pages 41 to 130.



WP200 Printer Interface

Telecommunications

The CSA 907A Bit Error Rate Tester is used to evaluate transmission quality of high speed modules and systems for a variety of testing applications including SDH/SONET, FDDI, and satellite communications.

See Telecommunications Section on pages 224 to 255.

CSA 907A Bit Error Rate Test Set

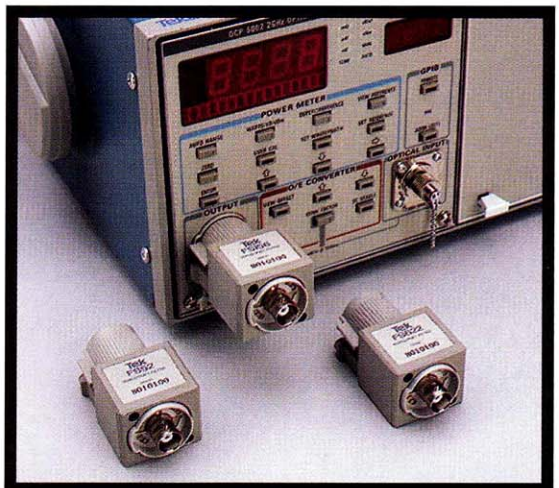
The OME 1400 Optical Standards Test System is a configured solution for SDH/SONET and FDDI communications network testing. Supplied with a PC or workstation, application development software (LabVIEW), and a full complement of signal analysis and O/E conversion hardware, it's ready to for you to begin developing your production tests.

See Systems Section on pages 262 to 275.

OME 1400 Test Systems

The ORS Series, individually calibrated optical receivers certified to meet CCITT's SDH/SONET specifications, provides low noise and high precision for SDH/SONET transmitter evaluation.

See Telecommunications Section on pages 224 to 255.



ORS Series Optical Receivers

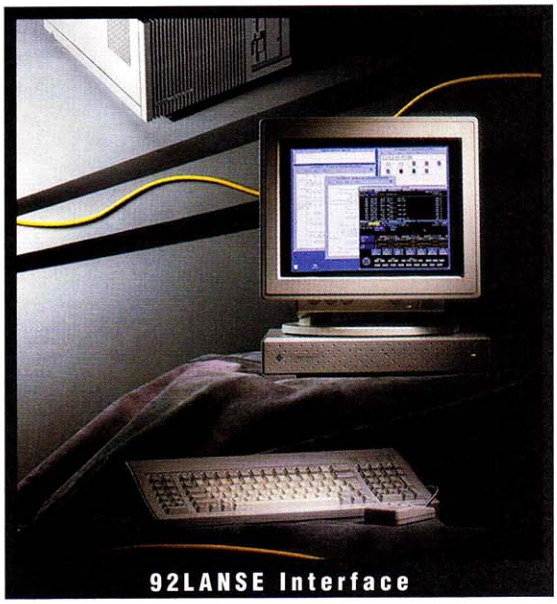
Fiber-optic transmission technology has raised the standard for signal quality in telephone, broadcast, and satellite communications, among others. Tektronix' high-performance measurement tools for telecommunications combine the company's renowned low-noise and high bandwidth acquisition technology with a full range of high-purity O/E conversion and conditioning adapters.

Logic Analyzers

Tektronix logic analyzers are found wherever digital systems are designed or maintained. As concurrent design methodologies take hold, Tektronix LAs are integrating into the EDA world via networking. When all the simulation and emulation is done, system engineers rely upon logic analyzers to verify the real outcome of their designs. There the LA acts as a work-station- controlled measurement tool, an equal partner in the design process.

The 92LANSE interface integrates the DAS 9200 Series systems analysis tools to workstation networks via Ethernet.

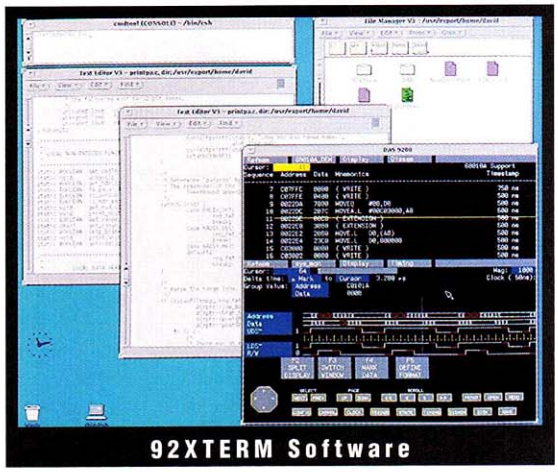
See Logic Analyzer Section on pages 151 to 184.



92LANSE Interface

The 92XTERM software brings the DAS user interface to the Sun workstation environment to help system integrators and designers more effectively verify and debug complex embedded systems.

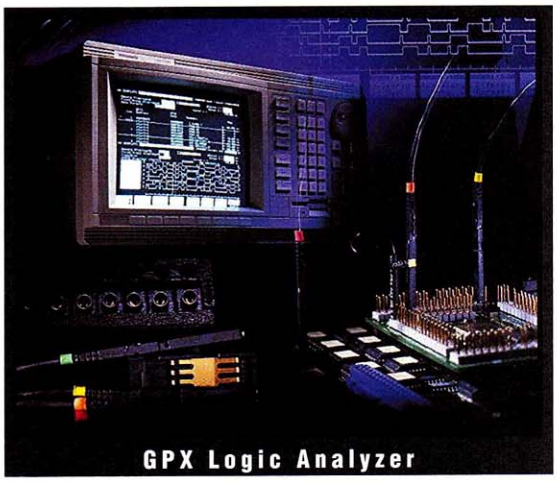
See Logic Analyzer Section on pages 151 to 184.



92XTERM Software

The GPX general-purpose logic analyzer puts eight powerful logic analysis tools into one cost-effective instrument. It supports the fastest microprocessors and offers high speed (up to 1 GHz), high resolution acquisition modes.

See Logic Analyzer Section on pages 151 to 184.



GPX Logic Analyzer

Spectrum Analyzers

The 2790 Series portable, rugged Spectrum Analyzers includes four models suitable for applications ranging from land mobile to satellite communications.

See Spectrum Analyzer Section on pages 185 to 215.

2790 Series Spectrum Analyzers

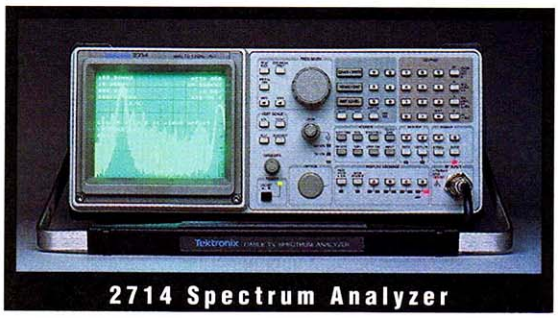
The 2784 premium performance Microwave Spectrum Analyzer provides a preselected coaxial frequency range to 40 GHz. With its simplified user interface, it is the industry leader in accessible spectrum analyzer performance.

See Spectrum Analyzer Section on pages 185 to 215.

2784 Microwave Spectrum Analyzer

The 2714 Cable TV spectrum analyzer automates more than a dozen of the most critical cable TV measurements. With built-in automated data collection, it's ideal for unattended cable and LAN monitoring.

See Spectrum Analyzer Section on pages 185 to 215.



2714 Spectrum Analyzer

Spectrum Analyzers (SA) let us see the sidebands, distortion, and harmonics that make up the "signal within the signal." Tektronix spectrum analyzers have set the performance standards in their field for years, and continue to do so. A cornerstone of the telecommunications and broadcasting fields, Tektronix SAs help ensure conformance to FCC and international standards for wired, optical, and wireless communications.

More Test & Measurement

Tektronix' broad line of signal sources, power supplies, counters, and meters supplements its scope-based measurement tools in the lab, field, factory, or classroom. Selections range from cost-effective benchtop service instruments to programmable modular products that stand with the best the industry has to offer.

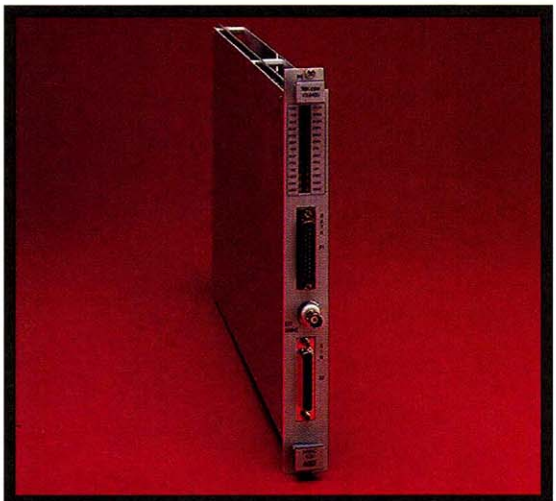
The 372 Semiconductor Workbench combines the advanced features found in parameter analyzers with a curve tracer's interactive user interface and sourcing capability. The 372 provides the measurement capabilities and advanced analysis required for IC research, design, manufacturing and quality assurance testing.

See Semiconductor Testers Section on pages 395 to 403.

372 Semiconductor Workbench

The VX4469 is at the heart of Tektronix' avionics test capability. This VXI module transmits and receives on up to three ARINC 629 busses simultaneously, and includes a throughput-enhancing high-speed data register architecture. Of course, it conforms to Tektronix' policy of fully open systems compatibility.

See Systems Section on pages 262 to 275.



VX4469 Module

Tektronix' seven new programmable arbitrary generator products—two built on the TDS architecture and five in the TM5000 series—replicate real-world signals from sources like disk-drives and anti-lock braking systems.

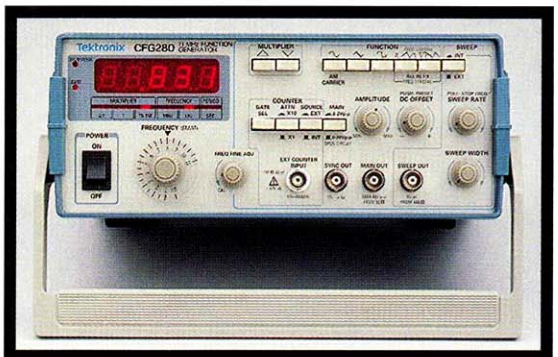
See Modular and Standalone General Test Instruments Section on pages 285 to 369.

AWG/AFG 2020

More Test & Measurement

The CFG 280 function generator provides sine, square, and triangle waveforms, and TTL signals, at frequencies from .1 Hz to 11 MHz. Its built-in frequency counter helps you set the output frequency precisely.

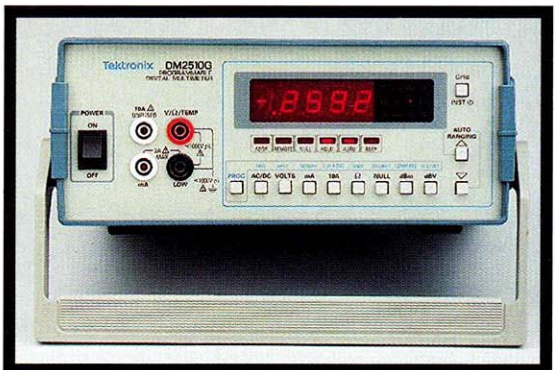
See Basic Bench Instruments Section on pages 370 to 390.



CFG 280 Function Generator

The DM2510 is an autoranging six-function digital multimeter that is cost-effective for the factory, the service bench, or the classroom.

See Basic Bench Instruments Section on pages 370 to 390.



DM 2510 Digital Multimeter

The J17 photometer uses interchangeable pre-calibrated heads to make light measurements—illuminance, irradiance, luminance, radiance, LED output, and color—and also includes smart features like auto-ranging and one-button English/Metric unit conversion.

See Photometer Section on pages 404 to 406.

Photometer

Tektronix has become known for providing extraordinary value in its instruments. By selectively applying technologies used in its high performance laboratory products, Tektronix is able to offer unequalled power and versatility in its classroom and field instruments.

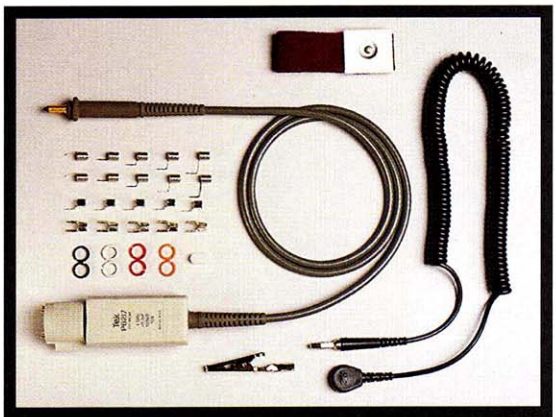
Accessories

Probing of electronic circuits is increasingly difficult due to the ever-denser ICs and circuit boards that are common today. And the connection between device under test and instruments is more critical, thanks to increasing device speeds and decreasing circuit voltages and currents.

Tektronix' line of specialty probes provides the signal fidelity and physical integrity needed for modern measurement challenges.

The new P6217 and P6207 Active FET probe provides Low Circuit Loading for CSA (Communications Signal Analyzers), DSA (Digitizing Signal Analyzers), 11000 Series and the TDS Family of Oscilloscopes. The P6217 and P6207 with FET input devices provide very high input resistance and ultra low input capacitance.

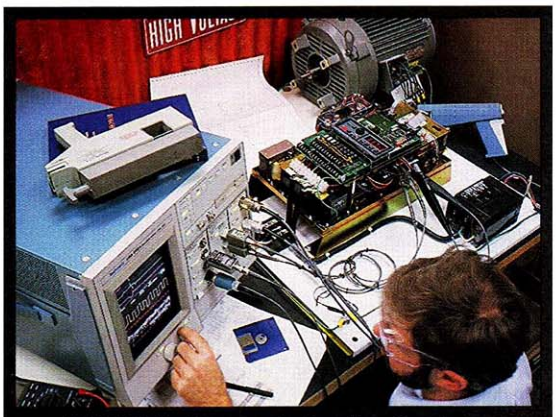
See Accessories Section on pages 423 to 489.



P6217 Active FET Probe

With the AM503S Current Probe System (featuring the new AM503A Current Probe Amplifier) you can accurately measure both high frequency AC and DC currents simultaneously–a capability no other probe system on the market offers.

See Accessories Section on pages 423 to 489.



AM503S Current Probe System

PQFP 132 SMD probing clip makes it easy to connect your scope or LA probe to PQFP's on today's densely populated circuit boards. And your signals won't suffer—bandwidth is 350 MHz.

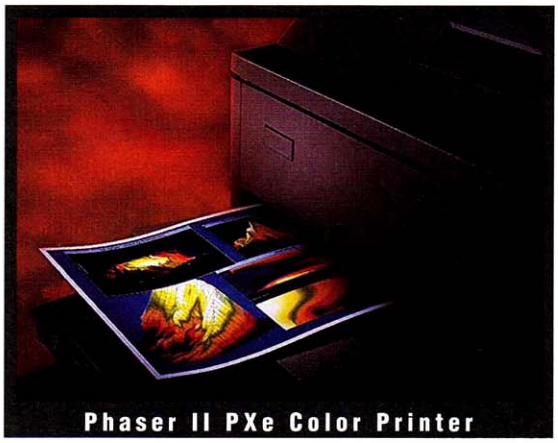
See Accessories Section on pages 423 to 489.

PQFP 132 Adapter Clip

Computer Graphics and Television

The Phaser II PXe color printer brings your presentation to life with photo-quality images on overhead transparency media; 17 resident fonts and Postscript Level 2 give you professional results for engineering and graphic arts printing applications.

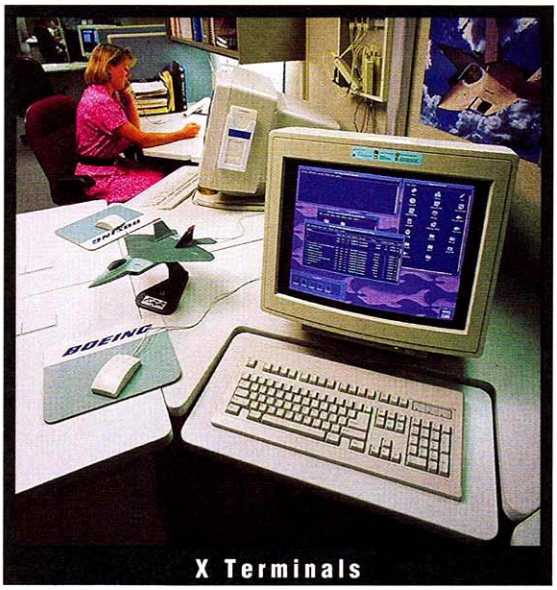
See Computer Graphics Section on pages 505 to 512.



Phaser II PXe Color Printer

The X Terminals provide parallel processing of graphics and networking at blazing speed, just the solution for X-based applications in telecommunications, aerospace, electronics, and manufacturing applications.

See Computer Graphics Section on pages 505 to 512.



X Terminals

The 1740/1750A/1760A Series make up a family of analog video waveform/vector monitors with progressive features in support of today's demanding television environment. The series provides improved video performance, ease of operation, and application specific features as well as models for NTSC, PAL, or dual standard NTSC/PAL operation.

See Television Section on pages 491 to 504.

1740A Waveform/Vector Monitors

Many electronic measurements—waveforms, digital events, etc. eventually find their way into some kind of document or graphic record. Tektronix' color printers are perfectly matched to the task of printing such records, as well as everything from postcards to T-shirts transfers, in vivid color.

Tektronix offers traditional graphics terminals and most recently, X terminals–devices that provide windowed access to multiple hosts and applications across a network.

If you've watched broadcast or cable television anywhere in the world, chances are you've seen Tektronix television equipment at work. Tektronix serves the TV industry with advanced production, distribution, and test equipment.

Oscilloscopes

From the highest performance to the most cost-effective solution, Tektronix offers a broad range of test and measurement instrumentation. Tektronix instruments provide the best connection to your device-under-test, the most accurate signal acquisitions, the sharpest waveform displays, and the most comprehensive on-board waveform measurements available.

Whether you choose analog or digital technologies, each have benefits and tradeoffs. The following pages present Tektronix' analog and digitizing oscilloscope solutions.

The oscilloscope section begins with a general reference section on pages 42-48. Our digitizing oscilloscopes begin on page 49, providing information for the TDS Series, 11000 Series, (including plug-ins), DSA Series, 2400 Series, 2200 Series, and 200 Series Oscilloscopes.

The analog oscilloscopes begin on page 114 with the TAS Series, followed by the 2400 Series and 2200 Series.

It takes a broad range of oscilloscope products to satisfy the spectrum of measurement applications throughout the world today... and Tektronix delivers that product line breadth sought after by customers worldwide.

CONTENTS

REFERENCE 42

DIGITIZING OSCILLOSCOPES

TDS Series 50
11000 Series 65, 85
DSA Series 65, 68
11000 Series Plug-ins 78
2400 Series 97
2200 Series 101
200 Series 110

ANALOG OSCILLOSCOPES

TAS Series 114
2400 Series 118
2200 Series 123

Oscilloscope Reference

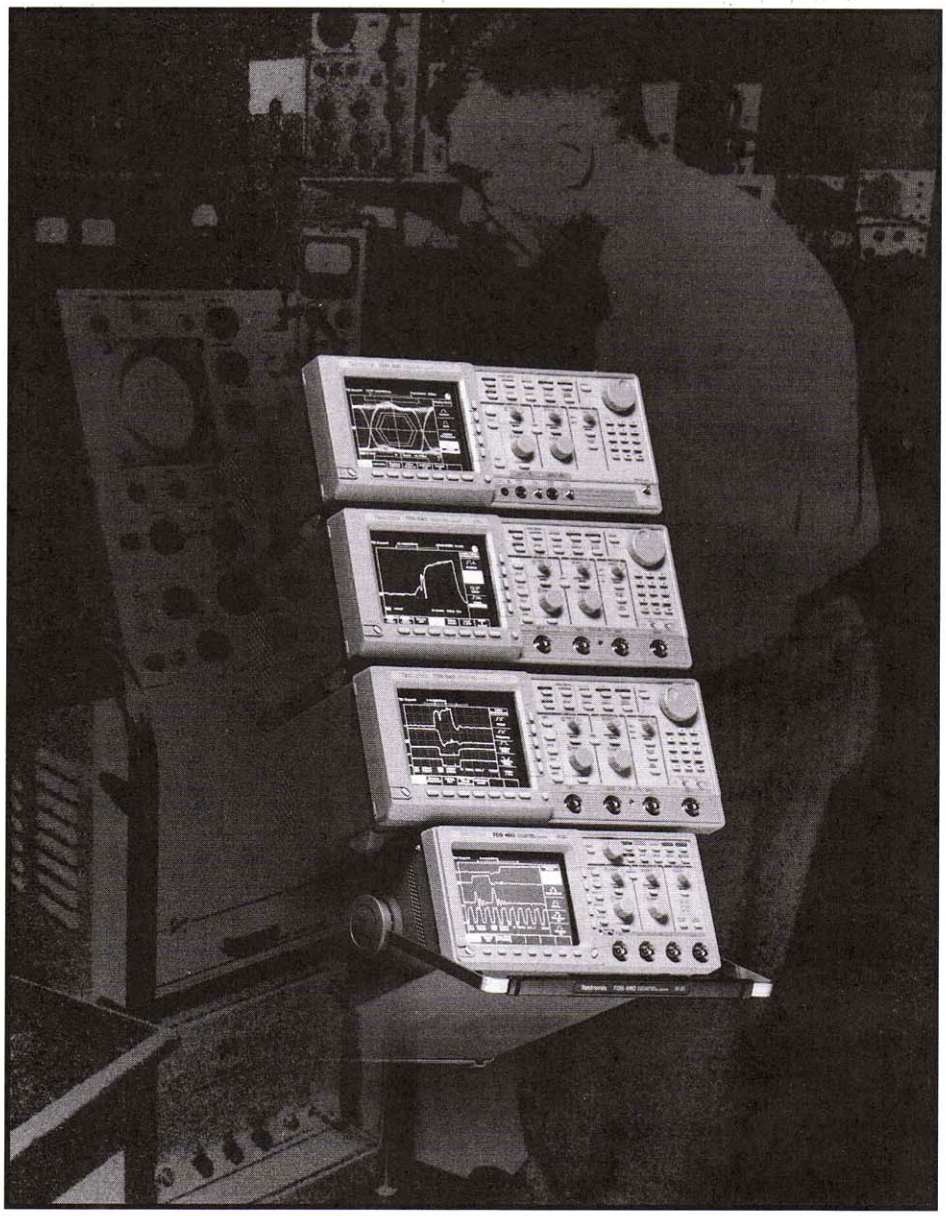
Tektronix quality and reliability.

DIGITAL OSCILLOSCOPES

- TDS Series
- 11000 Series
- DSA Series
- CSA Series
- 11000 Series Plug-ins
- 2400 Series
- 2200 Series
- 200 Series

ANALOG OSCILLOSCOPES

- TAS400 Series
- 2400 Series
- 2200 Series

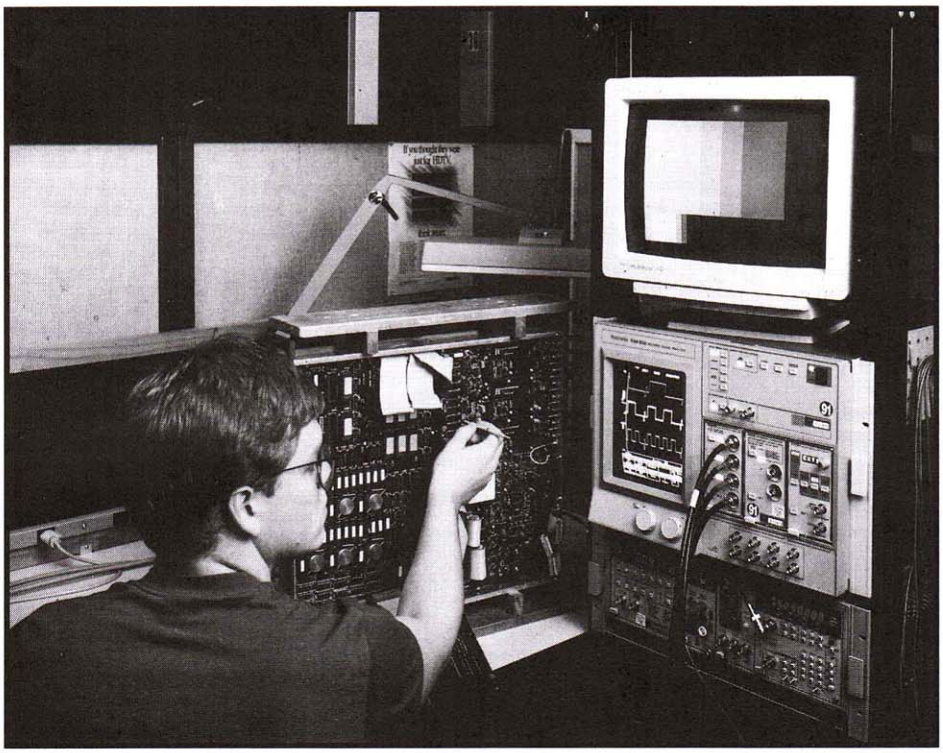


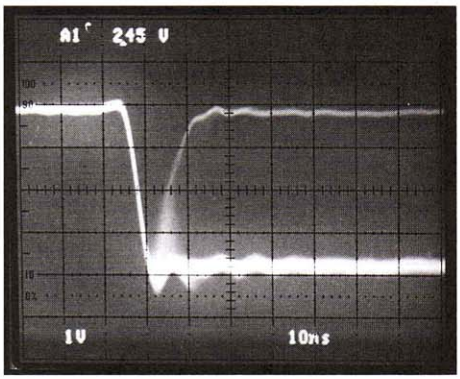
Tektronix Oscilloscopes

Oscilloscopes are the window through which we view the electronic world. They are fundamental to developments in research, design, manufacturing and service. Tektronix and oscilloscopes are synonymous. We've grown up together. There is no trick we haven't tried, no technology we haven't applied to widening that window in search of a clearer and more accurate view.

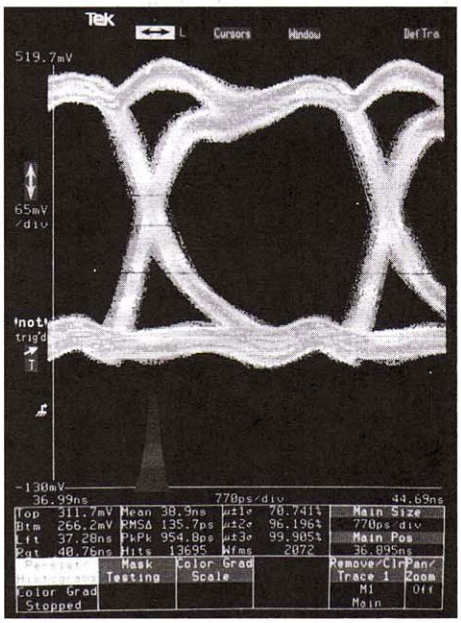
Customers continually challenge us to improve. We respond by combining existing features for specific applications or by developing new features to keep ahead of ever-changing needs. On the following pages, you'll find our response to those challenges; a wider selection of oscilloscopes and waveform digitizers than you can find anywhere else.

Oscilloscope Reference





The microchannel plate CRT in the 2467B BrightEye® displays low repetition rate events and helps uncover elusive problems in digital circuits.



- Low cost analog oscilloscopes for the service technician and home hobbyist.
- Combination analog and digital storage technologies for flexibility in a single instrument.
- Digitizing oscilloscopes with extraordinary power to capture fast transient signals, process them on the fly and measure their parameters.
- The TDS 640 which helps digital designers quickly zero in on complex logic problems in high speed digital systems.
- The CSA communication channel analyzers that can give an accurate assessment of noise and jitter.
- High performance analog scopes like the 2467B BrightEye® with a micro-channel plate CRT to brightly display single shot or low repetition rate signals up to 400 MHz.
- A selection of over 40 general and special purpose scopes and digitizers.
- The High Bandwidth (50 GHz) 11801A offers the highest timing resolution and measurement repeatability. While the TDS 800 combines the sequential equivalent-time sampling technology of the 11801A with the mid-range TDS platform for DC-8 GHz Bandwidth in a portable monolithic instrument.

These products include many innovative features designed to help our customers improve their productivity and reduce operating costs. We have two new oscilloscope platforms in this catalog, the TDS Series of digitizing oscilloscopes and the TAS Series of analog oscilloscopes. They represent the best combination of performance features, human factors and price on the market today. There are other vital technologies only available from Tektronix such as:

- DC to 60 MHz Current Measurements
- Affordable Digital Signal Processing
- BrightEye® Microchannel Plate CRTs to clearly show infrequent events.
- Color-graded displays which give a statistical look at jitter and noise.

For complete information on all Tektronix oscilloscopes, please see pages 49-130.

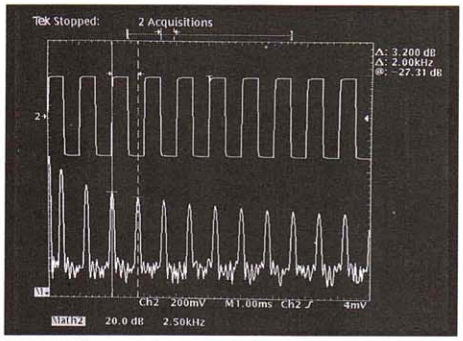
Tektronix Quality and Reliability

Tektronix oscilloscopes' quality and reliability are unmatched. Designs are thoroughly scrutinized and tested to insure compliance with all applicable safety and environmental standards. Calibration is traceable to national standards and conforms to military procedures. Our service network is designed to help you keep your oscilloscope calibrated and working with fast turnaround.

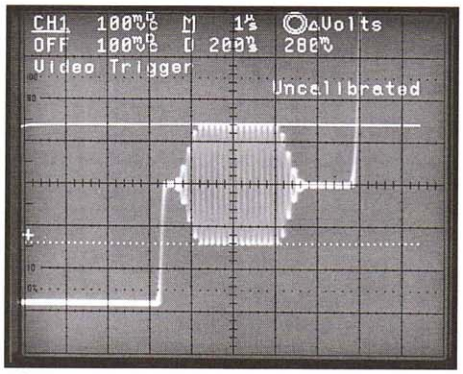
Continued on next page.

Oscilloscope Reference

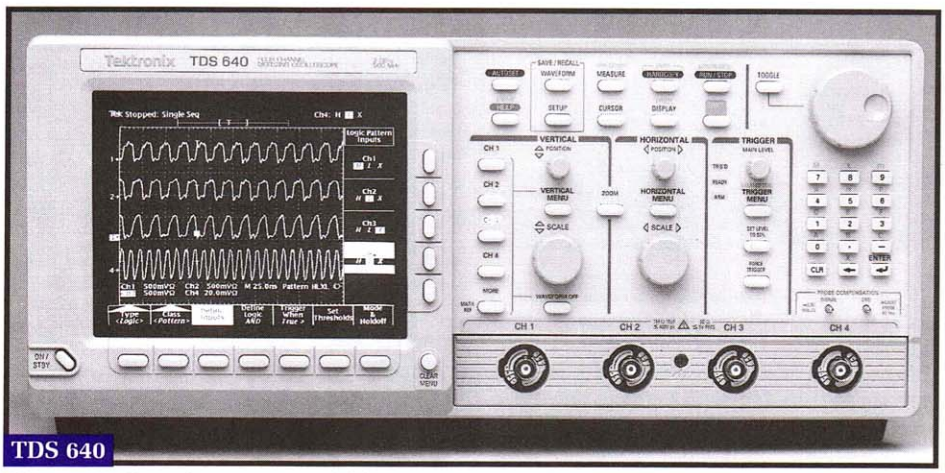
General Trends



Tektronix' exclusive TriStar™ DSP engine brings simultaneous time and frequency domain analysis to mid-range scopes in the TDS 400, TDS 500 and TDS 600, TDS 800 products.

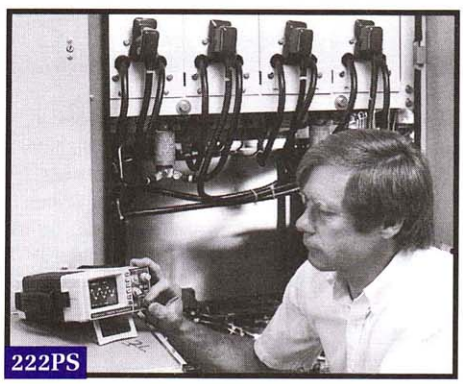


The new TAS 400 Series of analog scopes provides powerful features such as cursor measurements and autosetup in an easy to operate and low-cost package.



TDS 640

The new TDS 640 features powerful logic triggering and 2 GS/second sampling on all four channels at once. A graphic user interface helps make it a powerfully simple digital design tool.



222PS

The 220 family of hand-held DSOs helps make measurements in difficult environments safely and accurately.

General Trends in Oscilloscope Development

Today you will find more and more special purpose oscilloscopes. Examples include the 222 PowerScout, a hand-held digitizing scope with isolated inputs for safe and accurate troubleshooting of AC power distribution systems and the CSA 803 and 11801A with bandwidth to 50 GHz and color graded display for thorough analysis of high speed communication channels and standards testing.

Scopes are smarter today. Our new low-cost TAS analog scopes have autoset for one-button signal capture and cursors to measure time and amplitude.

Our TDS Series scopes and the DSA 600 include powerful digital signal processing engines which can give you simultaneous time and frequency domain displays with fast updates.

Our scopes are getting easier to use. We've reversed the trend toward more buttons and menus. Our new TDS and TAS models achieve a balance between performance and ease of use. We've done our homework, tested our ideas and greatly improved access to important new features without making the basic functions hard to find. Volts/division, time/division and trigger level have dedicated knobs so you can just grab and twist. Measurement, trigger modes, hard copy setups and acquisition control lie within easy reach behind a graphic user interface (GUI).

New Models for 1993

The breakthrough TDS Series of digitizing scopes has greatly expanded. Check out the TDS 640 and 620 with 2 GS/s sampling rate on up to four channels and powerful logic, glitch and runt triggering; and the TDS 840 and 820 with up to 8 GHz bandwidth and 0.4 ps timing resolution for very cost effective device characterization and communications applications. You'll also find new options to the TDS 500 and TDS 600 lines which include FFT and hard copy interfaces.

TAS 400 Series New Analog Scope Platform for the 90's

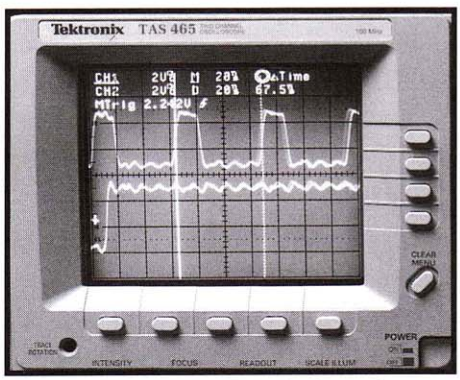
We've completely updated the analog oscilloscope to make it easier to use, more reliable and more powerful and still kept the price low. Tektronix' commitment to the analog scope user shows in these exciting new products.

The P6205 is a very popular new FET probe perfectly suited to probing higher speed digital devices with minimal loading effects. It comes standard with the TDS 600 scopes or can be purchased separately for a very reasonable price.

Oscilloscope Reference
Selection Guide

Selecting an Oscilloscope

Sometimes, the application dictates the oscilloscope selection. Other times it's purely a matter of personal preference or budget. In any case, we can help you make the right decision. The following decision tree will help steer you in the right direction. Refer to following pages for detailed descriptions of the families and individual models of Tektronix oscilloscopes and digitizers. Or simply call an authorized Tektronix representative to get some expert assistance.



The new TAS 400 family is the first of a new series of analog oscilloscopes built upon an entirely new platform. TAS scopes combine powerful features with a very simple front panel that enables the user to unleash the power of this new scope family.

OSCILLOSCOPE SELECTION GUIDE

Storage/Analog	Bandwidth	Repetition Rate	Models
Storage	≥500 MHz	Repetitive	11801A CSA 803 CSA 404 TDS 800s 11403A DSA 600As TDS 500s
		Nonrepetitive	SCD 1000 SCD 5000 DSA 600As RTD 720A TDS 600s
	<500 MHz	Repetitive	TDS 400s 2400 DSOs 220 DSOs 220 Family
		Nonrepetitive	RTD 710 TDS 500s TDS 400s 2400s DSO 2200s DSO 222, 224
Non-storage	<500 MHz	Repetitive	TAS 400s 2400Bs Analog 2200s Analog
		Nonrepetitive	2467B/BHD

Oscilloscope Reference
Selection Guide

DIGITIZING OSCILLOSCOPES AND WAVEFORM DIGITIZERS

Model	Bandwidth	Sample Rate	Vertical Resolution	Record Length	Channels	Computer Interfaces	Page
CSA 803 CSA 404	300 MHz to 50 GHz	200 kS/s to 20 MS/s	8 to 10 bits	5k to 10k points	1 to 12	GPIB, RS-232C, Centronics	250 246
11801A	3.0 GHz to 50 GHz	200 kS/s	8 bits	5k points	1 to 136	GPIB, RS-232C, Centronics	85
DSA 600A	Up to 1 GHz	1 to 2 GS/s maximum	8 bits	20k to 30k points	1 to 12	GPIB, RS-232C, Centronics	68
11403A	Up to 3 GHz	20 MS/s maximum	10 bits	10k points	1 to 12	GPIB, RS-232C, Centronics	72
TDS800	6 to 8 GHz	n/a	14 bits	15k points	2 to 4	GPIB (RS-232C, Centronics Opt.)	54
TDS 600	500 MHz	2 GS/s	8 bits	2k points	2 to 4	GPIB	56
TDS 500	500 MHz	1 GS/s maximum	8 bits	500 to 50k points	2 to 4	GPIB	56
TDS 400	150 to 350 MHz	100 MS/s	8 bits	500 to 30k points	4	GPIB	60
2400 DSOs	150 to 300 MHz	100 to 500 MS/s	8 bits	1k points	2	GPIB	97
222A/224	10 MHz	10 MS/s	8 bits	512k points	2	RS-232	110
RTD 710 RTD 720A	500 MHz	200 MS/s to 2 GS/s	8 to 10 bits	128k points to 32 M points	2	GPIB	138 135
SCD 1000 SCD 5000	1 GHz to 4.5 GHz	200 GS/s	11 bits	1k points	2	GPIB	132

ANALOG PLUS DIGITAL OSCILLOSCOPES

Model	Bandwidth	Sample Rate	Record Length	Vertical Resolution	Channels	Computer Interfaces	Time Bases	Page
2232	100 MHz	100 MS/s	1k to 4k points	8 bits	2	GPIB & RS-232 Opt.	Dual	106
2221A	100 MHz	100 MS/s	1k to 4k points	8 bits	2	GPIB & RS-232 Opt.	Single	106
2212	60 MHz	20 MS/s	4k points	8 bits	2	GPIB & RS-232 Opt.	Single	102
2201	20 MHz	10 MS/s	2k points	8 bits	2	RS-232 hardcopy	Single	104

ANALOG OSCILLOSCOPES

Model	Bandwidth	Channels	Time Base	Cursors	Auto Setup	Computer Interfaces	Page
2400B	200 to 400 MHz	2 + 2 aux.	dual	yes	yes	GPIB Opt.	118
2200	20 to 100 MHz	2 or 2+2	single or dual	2252 2247A 2245A	2252 2247A 2245A	GPIB, Centronics on 2252 only	123
TAS 400	100 MHz	2	dual	yes	yes	no	114

Oscilloscope Reference

Data Management

Data Management Solutions for Oscilloscopes

Digitizing oscilloscopes produce incredible amounts of data and information about waveforms. So much, in fact, that it is often hard to make the best use of it. In addition, programmable scopes open doors to a wide range of possibilities for test and procedure automation.

Tektronix offers several software solutions to these data management and control problems with software for:

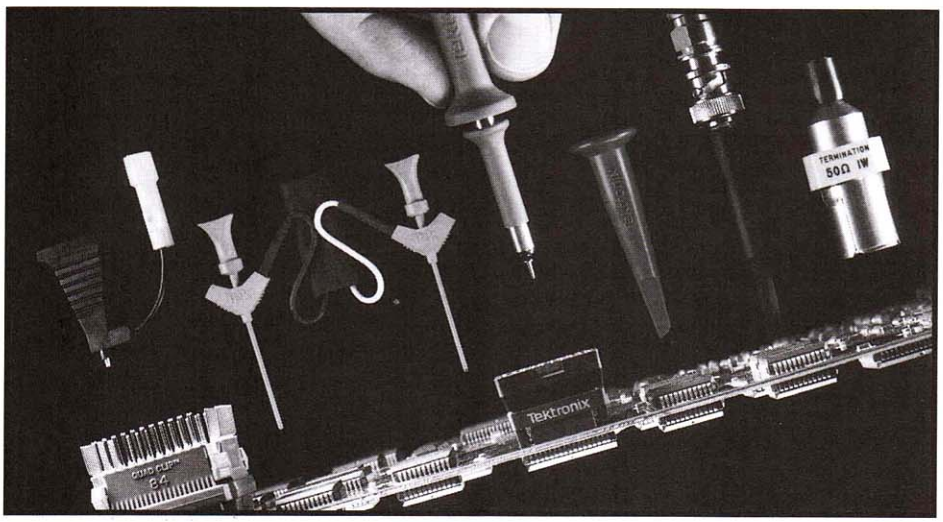
- saving and recalling waveforms and settings
- handling graphic images of screens and waveforms for documentation
- data logging
- procedure generation and execution
- data analysis and graphics
- remote control

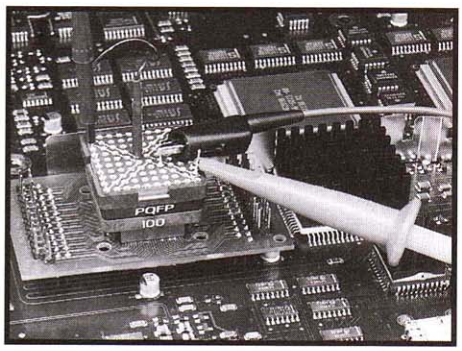
Here's a brief summary of the packages and the products that they support.

Product Name	Product Number	Description	Oscilloscopes Supported
Tektronix TMS/IPG	S3FT100	Interactive Procedure Generator	TDS Series, 11400A, CSA 404, 2430A, 2440, 2200 DSOs
Tektronix TMS/RTG	S3FT110	Run Time Generator	TDS Series, 11400A, CSA 404, 2430A, 2440, 2200 DSOs
Tektronix TMS GPIB/VXI Instrument Libraries	S3FT300/200	Front Panel Editor	TDS Series, 11400A, CSA 404, 2430A, 2440, 2200 DSOs
Lab Windows/Advanced Analysis Libraries	S3FG910/912	Data acquisition, analysis, and instrument control	TDS Series, 11400A, CSA 404, 2430A, 2440, 2200 DSOs, RTD 710
LabView PC Windows LABView Sun SPARC	S3F6919 S3F6920	Data acquisition, analysis, & graphics	TDS Series, DSA 600, 11801A, CSA 803, 11400A, CSA 404, 2430A, 2440, 2200 DSOs, 220 Family DSOs, RTD 710A RTD 720A
WaveWriter™	S3FT400	Waveform capture generation and editing	TDS Series, 11400A, CSA 404, 2430A, 2440, 2200 DSOs
TDS Data Manager	S34TDS1	Waveform and settings storage, Graphics and Data management	All TDS Series
11000 Series DSO Utilities	S47P108	Waveform & measurement storage, graphics, instrument control	DSA 600A, 11400A, 11800A, CSA 803, CSA 404
CAT 200	CAT 200	Remote control for field service	222A, 222PS, 224
WaveSaver	S41SAVE	Waveform transfer, storage and graphics	2221A, 2230A, 2232 with RS-232
Integrated TeleServicing	S41TSS1	Remote control and data transmission	2221A, 2230A, 2232 with RS-232

Continued on next page.

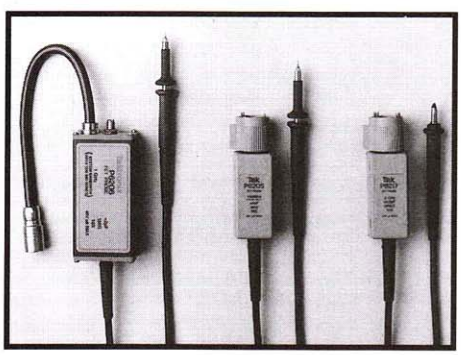
Oscilloscope Reference
Accessories





New Probes and Accessories

Tektronix continues to dedicate research and development resources to helping customers find ways to connect oscilloscopes to new devices and packages. You will find some innovative new probes and connecting schemes that quickly and cleanly couple to all kinds of devices.



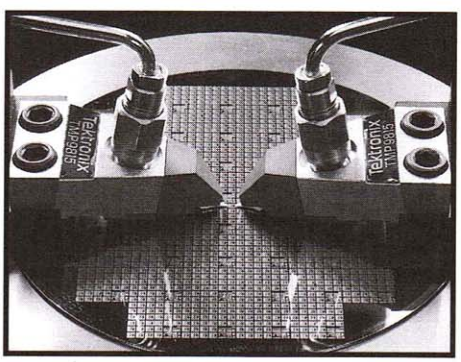
FET PROBES

The P6204, P6205, P6206, P6217, and P6207* FET probes prove that today's high speed logic circuits can be probed with minimal loading effects. These active probes provide 500 MHz to 4 GHz bandwidth and high input impedance to insure that what you see is an accurate depiction of what is happening in your circuit.

** The new P6207 and P6206 has the newly developed TEKPROBE SMA Interconnect technology.*

B-SERIES

B-Series 15-100 MHz probes set new standards for durability and accuracy for general purpose applications. An entirely new design eliminate wiring and soldered connections, the most common causes of probe failure.

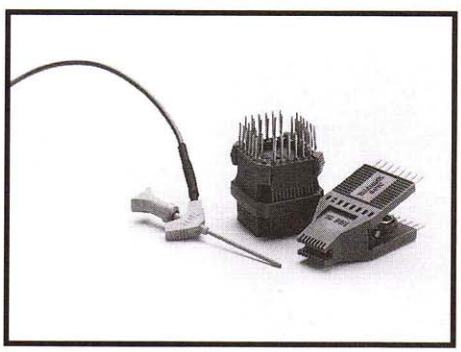


MICROWAVE PROBES

For microwave and millimeter wave application, refer to the new TMP9600 and TMP9800 Probes. These powerful new products allow probing of semiconductor wafers and hybrid substrates with 20 GHz to 60 GHz bandwidths. The CAL93 and CAL96 calibration substrates provide impedance references to insure accurate device and process characterization.

CLIPS AND INTERCONNECTS

You will find a complete line of clips and interconnects for all kinds of packages. The SMT KlipChip™ allows logic and scope probes to connect directly to surface mount devices (SMD). There are clips for Plastic Leaded Chip Carriers (PLCCs) and Small Outline Integrated Circuits (SOICs). And the PQFP100/132 provides easy probe access to soldered 100 or 132 pin Plastic Quad Flat Packs (PQFPs).



Digitizing Oscilloscopes

TDS Series

An innovative series of oscilloscopes built upon Tektronix' new digitizing oscilloscope platform, featuring multi-processor speed and flexibility, advanced acquisition and triggering capabilities and a unique graphical user interface for intuitive operation.

11000 Series

The Tektronix 11000 Series is a powerful set of analysis tools that alters your fundamental expectations of an oscilloscope. Accuracy, sensitivity, bandwidth, offset, and overdrive recovery are provided by a well-planned instrument family having plug-in versatility and performance.

DSA Series

The Digitizing Signal Analyzer (DSA) Series incorporates a dedicated digital signal processor (DSP). The DSA Series provides the fastest and most accurate real-time digitizer plus provides signal processing capability previously found only in large computer systems.

CSA Series

The Communications Signal Analyzer (CSA) Series offers signal analysis and the powerful measurement capabilities required to analyze high-speed digital, communication signals. Features include histograms, mask testing, and a color-graded display; allowing you to perform accurate measurements such as jitter, noise, and phase.

2400 Series

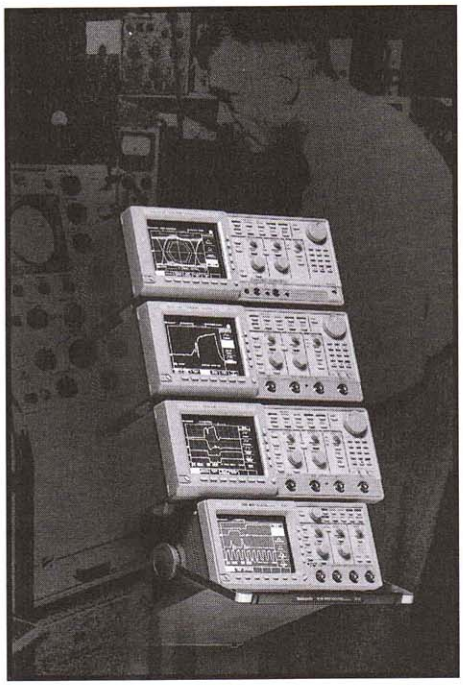
The 2400 Series offers a well balanced combination of performance, automation, and convenience features.

2200 Series

The 2200 Series offers digital storage and analog familiarity plus documentation at an affordable price.

200 Series

The compact size and battery operation make the 200 Series optimum scopes for industrial maintenance and field service.



CONTENTS

TDS SERIES OSCILLOSCOPES
General Information 50
TDS 840 8 GHz 54
TDS 820 6 to 8 GHz 54
TDS 640 500 MHz 56
TDS 620 500 MHz 56
TDS 540 500 MHz 56
TDS 520 500 MHz 56
TDS 460 350 MHz 60
TDS 420 150 MHz 60
TD 100 Data Manager 63

1100 SERIES OSCILLOSCOPES/PLUG-INS
11403A 3 GHz Color 72
11402A 1 GHz Monochrome 72
11000/DSA Series Plug-in Amplifiers 78
11801A 12.5 to 50 GHz Digital Sampling 85

DSA SERIES DIGITIZING SIGNAL ANALYZERS
DSA 602A 1 GHz 68
DSA 601A 1 GHz 68

CSA SERIES COMMUNICATIONS SIGNAL ANALYZERS
CSA 404 Up to 50 GHz 246
CSA 803 Up to 50 GHz 250
CSA 907A Bit Error Rate Tester 254

2400 SERIES DIGITIZING OSCILLOSCOPES
2440/2440M 500 MS/s 97
2430A/2430M 100 MS/s 97

2200 SERIES DIGITAL STORAGE + ANALOG REAL-TIME
2212 60 MHz 102
2201 20 MHz 104
2232 100 MHz 106
2221A 100 MHz 106
Software 109

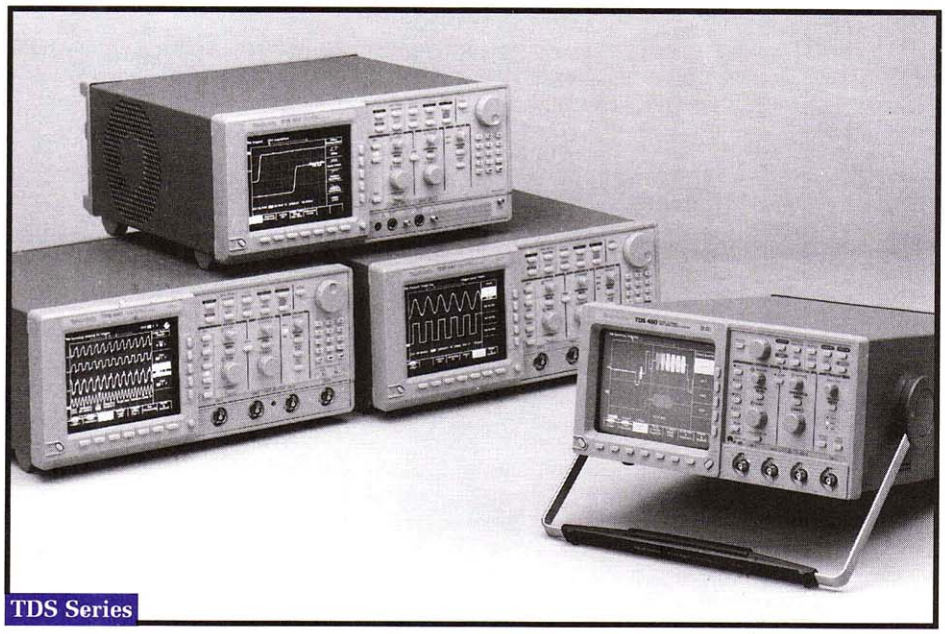
200 SERIES HANDHELD DIGITAL STORAGE
222A 10 MHz 110
222PS 10 MHz 110
224 60 MHz 110
Software 112

Digitizing Oscilloscopes

The breakthrough TDS architecture lends itself to an almost limitless range of price and performance variations.

TDS SERIES

- 150 MHz to 8 GHz Bandwidth
- 100 MS/s to 2 GS/s Sample Rates
- 2 and 4 Input Channels
- Advanced Logic Pattern and State Triggering
- Runt and Glitch Triggering
- Video Triggering
- Infinite and Variable Persistence Displays
- Record Lengths to 50,000 Points
- 8-14 Bit Vertical Resolution
- Tektronix TriStar™ DSP for Fast Waveform Processing and Live Measurement Updates
- Automatic Measurements
- Full GPIB Programmability
- 3-Year Warranty



TDS Series

TDS Series

An innovative series of oscilloscopes built upon Tektronix' new digitizing oscilloscope platform, featuring multi-processor speed and flexibility, advanced acquisition and triggering capabilities and a unique graphical user interface for intuitive operation.

With the TDS Series, Tektronix introduced a new and innovative generation of digitizing oscilloscopes designed to keep pace with current and evolving needs across the electronics industry. TDS combines the performance needed with the ease-of-use demanded by customers in digital design; research and development; electromechanical design; high speed component development and characterization; and telecommunications.

The TDS Series offers significant advantages over other oscilloscopes in four major areas:

HIGH-FIDELITY SIGNAL ACQUISITION

TDS offers sample rates ranging from 100 MS/s to 2 GS/s and bandwidths from 150 MHz to 8 GHz. TDS couples this performance with wide dynamic range, vertical resolution up to 14 bits, fast overdrive recovery and 1 mV/div sensitivity. You'll find a model that precisely fits your needs.

POWERFUL AND FLEXIBLE TRIGGERING

TDS 500 and 600 models feature very innovative and accessible logic triggering features that can isolate glitches, runts and timing problems quickly and reliably. Video triggering for NTSC, PAL, SECAM and custom video standards makes the TDS 400 an excellent choice for video and display system design. 2 GHz trigger bandwidth in the TDS 800 and very low jitter make it ideal for high speed component characterization and for telecommunications manufacturing, installation and maintenance.

MULTIPROCESSOR ARCHITECTURE

Our TriStar™ Digital Signal Processor complements the power of a Motorola 68020 in all TDS Scopes to permit more measurement flexibility, instant response to commands and live waveform math including FFT in the TDS 500 and TDS 600 Series and waveform pass/fail testing in the TDS 500, 600 and 800. Displays may be sent directly to a printer or plotter or exported as EPS(Encapsulated PostScript) or PCX(Microsoft Windows) files for use with common graphics and word processing software.

AFFORDABLE PERFORMANCE THAT IS EASY TO USE

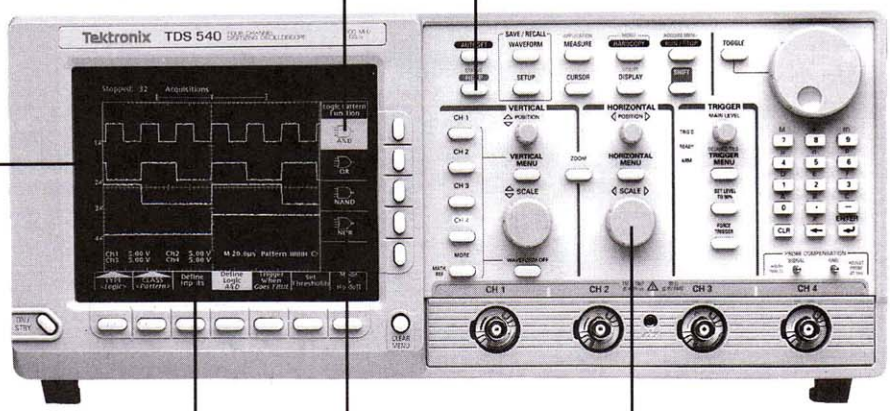
A new graphical user interface (GUI) makes operation intuitive. A familiar front panel layout puts dedicated knobs for vertical, horizontal and trigger controls right where you expect to see them. This layout makes it easy for casual users to operate the basic oscilloscope features. Explanatory icons, pop-up menus, online help and the VGA quality display quickly guide users to even the most powerful measurement features.

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

GPIB IEEE-488 — The TDS Series complies with IEEE Standard 488.2-1987, and with Tektronix Standard Codes and Formats.

Digitizing Oscilloscopes

TDS SERIES



Instead of forcing you to descend into a deep hierarchy of options, the side menu shows you all related options at a glance.

When in doubt, press the help button for explanation about any control or menu selection.

VGA-quality display helps make function icons more succinct and includes 16-level grayscale to bring out more precise waveform data.

Main menu is reduced to the simplest terminology.

Icons instantly describe and distinguish related menu functions.

Vertical, horizontal and trigger knobs are dedicated to a single function to eliminate confusion and false starts.

TDS Series

TDS SELECTION GUIDE

	TDS 420	TDS 460	TDS 520	TDS 540	TDS 620	TDS 640	TDS 820	TDS 840
Signal Acquisition System								
Bandwidth	150 MHz	350 MHz	500 MHz		500 MHz		6-8 GHz	8 GHz
No. of Channels	4	4	2	4	2	4	2	4
Vertical Resolution	8 bits ≥12 bits w/HiRes or averaging		8 bits ≥ 12 bits w/HiRes or averaging		8 bits ≥12 bits w/averaging		14 bits	
Vertical Sensitivity	1 mV-10 V		1 mV-10 V		1 mV-10 V		2 mV-200 mV/div	1 mV-100 mV/div
Accuracy	±1.5%		±1%		±1.5%		±0.7%	
Sample Rate	100 MS/s on all channels		500 Ms/s (1 CH) 250 MS/s (2 CH)	1 GS/s (1 CH) 500 MS/s (2 CH) 250 MS/s (4 CH)	2 GS/s on all Channels		NA	
Record Length Per Channel	500-5K pts. (30K Opt.)		500-15 k pts. (50 k Opt.)		500-2000 pts.		500-15 k pts.	
Peak Detection	10 ns		4 ns		NA		NA	
Signal Processing Functions								
	Add, Average, Envelope, HiRes, Interpolation (Sin(x)/x & linear), Multiply, Subtract		Add, Average, Envelope, HiRes, Interpolation (Sin(x)/x & linear), Multiply, Subtract Opt. FFT, Int., Diff		Add, Average, Envelope Interpolation (Sin(x)/x & linear), Multiply, Subtract Opt. FFT, Int, Diff.		Add, Average, Envelope Interpolation (Sin(x)/x & linear), Multiply, Subtract. Opt. FFT, Int, Diff.	
Triggering								
Trigger Conditioning	HF, LF & Noise Reject		HF, LF & Noise Reject		HF, LF & Noise Reject		NA	
Trigger Types	Edge, Auto, Init 50%; Custom, NTSC, PAL, SECAM video		Edge, Auto, Init 50%; 4 Input Pattern, State; Glitch and Width (≥2 ns); Runt		Edge, Auto, Init 50%; 4 Input Pattern, State; Glitch and Width (≥2 ns); Runt		Edge, Auto, Init 50%	
Page	**60**	**60**	**56**	**56**	**56**	**56**	**54**	**54**

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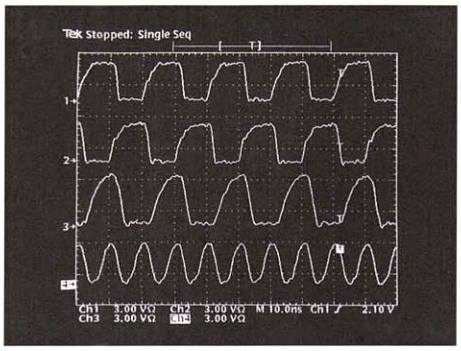
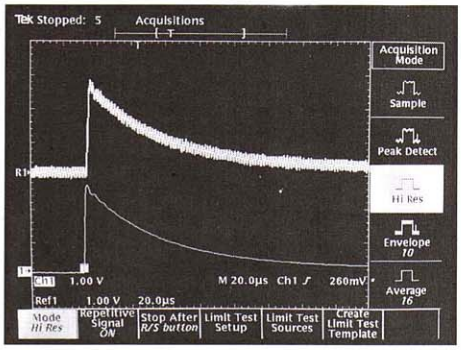
Digitizing Oscilloscopes

Powerful Acquisition

- Four Channels of 2 GS/s (TDS 640)
- Record Lengths of 50,000 Points (TDS 500 Opt. 1M)



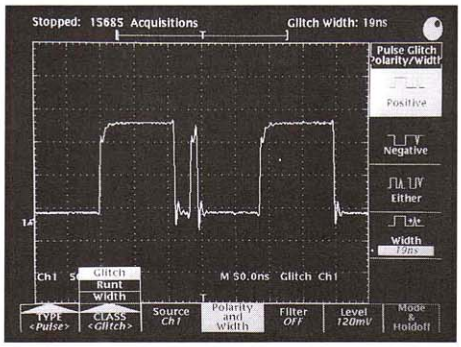
The TDS 640 provides four channels of 2 GS/s acquisition to capture events with high single-shot resolution.



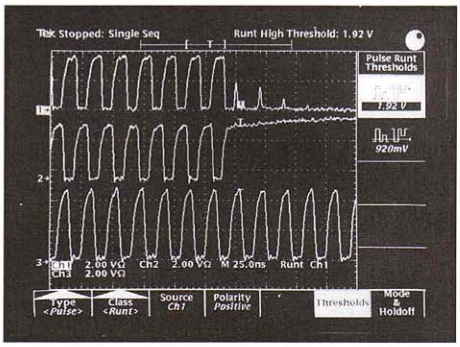
Hi-Res acquisition mode achieves extremely high signal to noise ratios (SNR) on single shot events by oversampling the input signal (all TDS 400 and TDS 500 models).

Advanced Triggering

- Glitch Trigger of 2 ns (TDS 500/TDS 600)
- Exclusive Runt Triggering (TDS 500/TDS 600)



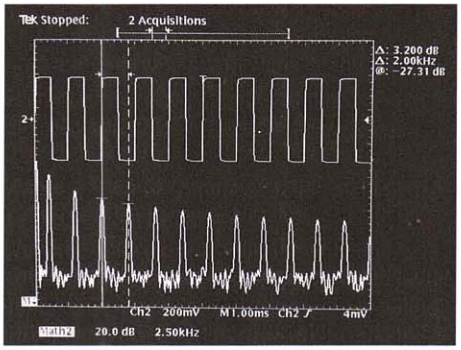
TDS triggering can capture glitches as narrow as 2 ns to help solve prototype circuit problems quickly (all TDS 500 and TDS 600 models).



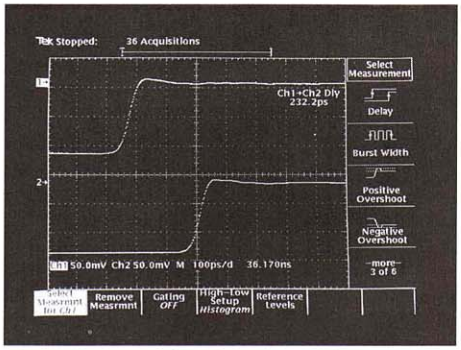
TDS exclusive runt triggering helps isolate invalid logic levels such as those caused by setup and hold violations (all TDS 500 and TDS 600 models).

Powerful Processing

- FFT Analysis
- Manufacturing Pass/Fail Testing
- On-board Mask Drawing (TDS 820/TDS 840)



FFT analysis provides an extra dimension of performance with simultaneous displays in the time and frequency domains (optional on all TDS 500, 600 and TDS 800 models).

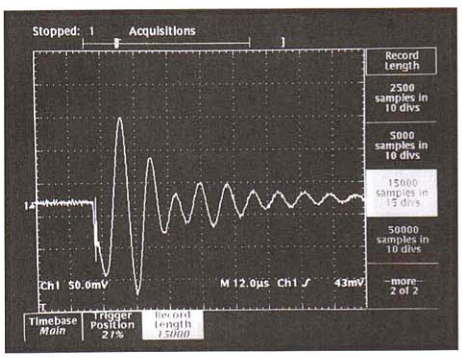


The TDS 820 and TDS 840 provide 0.4 ps timing resolution and channel deskew capability to accurately measure delays in today's high-speed digital systems.

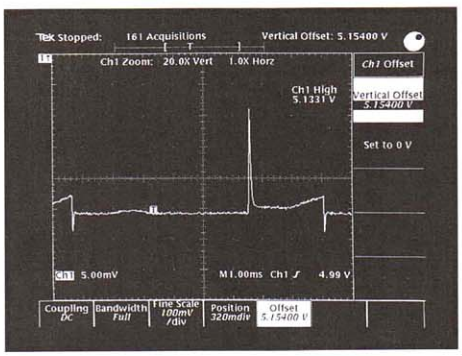
Digitizing Oscilloscopes

TDS SERIES

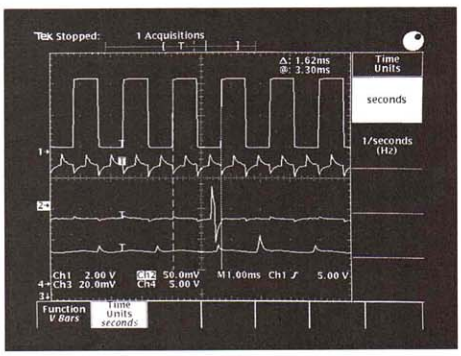
Powerful Acquisition



Record lengths of up to 50,000 points (TDS 500 Opt. 1M) enable very high timing resolution on even the most complex waveforms. Or capture unexpected events that happen well before or long after the trigger event.

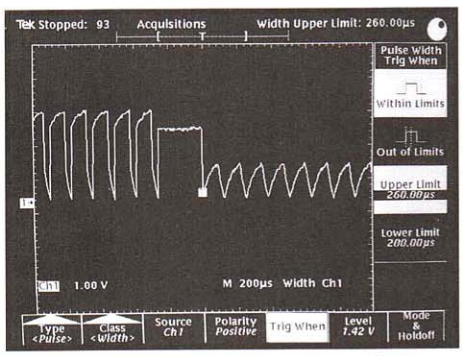


Calibrated vertical offset allows capture and analysis of small signals riding on top of large DC offsets (all TDS 400, TDS 500 and TDS 600 models).

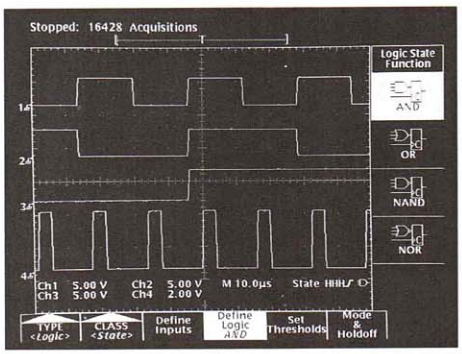


Four channels help show a time-correlated display of both digital control and analog feedback signals (TDS 420, TDS 460, TDS 540 and TDS 640).

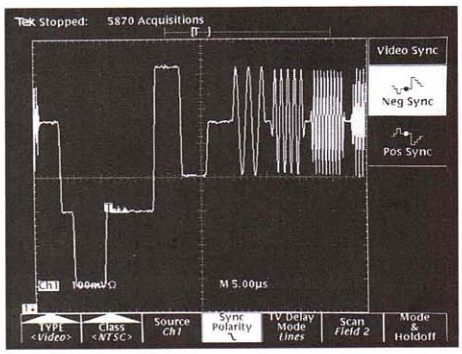
Advanced Triggering



Pulse width triggering can single out faults caused by pulses which are either too narrow or too wide (all TDS 500 and TDS 600 models).

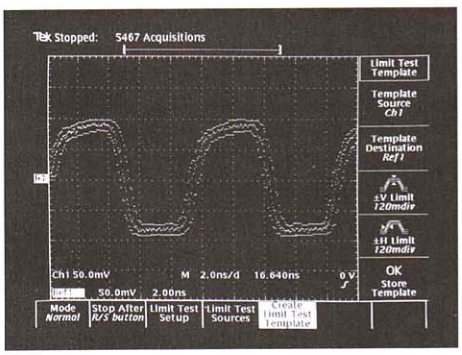


Logic timing analysis is clearly faster and easier with icon-driven state triggering (all TDS 500 and TDS 600 models).

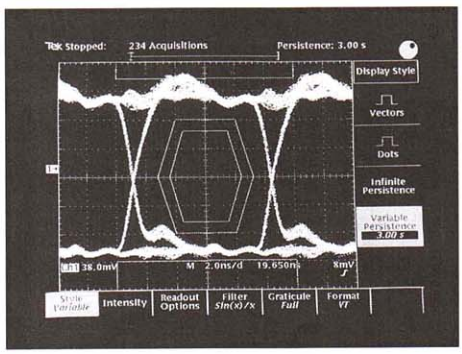


An optional video trigger features line and field selection on standard and custom video formats (TDS 420 and TDS 460).

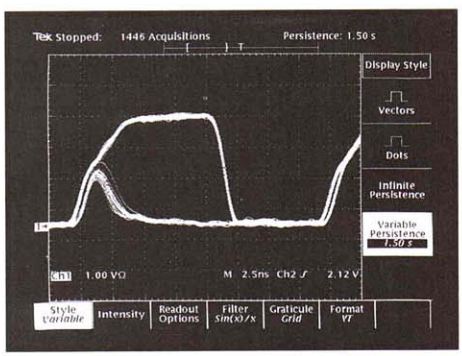
Powerful Processing



Automatic on-the-fly limit testing makes manufacturing pass/fail testing an easy task (all TDS 500, 600 and 800 models).



On-board mask drawing capability allows visual comparison of signals to standard masks in communication systems (TDS 800).



A variable persistence display mode lets you get a statistical view of waveform changes with 16 levels of intensity grading (all TDS models).

Continued on next page.

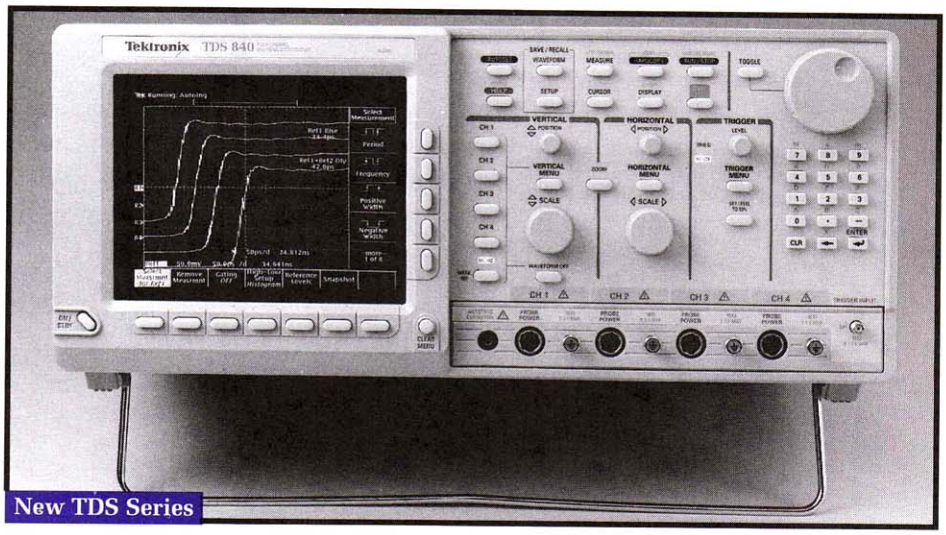
TDS 820
TDS 840

Digitizing Oscilloscopes

These high bandwidth, high resolution oscilloscopes are ideal for precise device characterization applications and for telecommunications service, manufacturing and installation.

TDS 820/840

- 6-8 GHz BW
- 0.4 ps Timing Resolution
- 2 and 4 Input Channels
- 20 ps/div to 2 ms/div Sweep Speeds in 5 ps steps
- 2 GHz External Trigger Bandwidth
- 3 ps RMS Jitter
- Infinite and Variable Persistence Displays
- 14 Bit Vertical Resolution
- 27 Automatic Measurements
- Electronic Mask Drawing and Display
- Automatic Pass/Fail Limit Testing
- Full GPIB Programmability



New TDS Series

SIGNAL ACQUISITION SYSTEM

	TDS 820	TDS 820 Opt. 1D	TDS 840
Channels	2	2	4
Rise time	58 ps	44 ps	44 ps
Bandwidth (0.35/rise time)	6 GHz	8 GHz	8 GHz
Max operating input voltage	2 Vp-p; ±3 VDC	1 Vp-p; ±1.5 VDC	1 Vp-p; ±1.5 VDC
Sensitivity	2 m V/div to 200 mV/div	1 mV/div to 100 mV/div	1 mV/div to 100 mV/div
Random noise	1.2 mV max 600 µV typical	600 µV max 300 µV typical	600 µV max 300 µV typical

DC Gain Accuracy – ±0.7% after user-initiated automatic vertical calibration.

Vertical Resolution – 14 bits (16,384 levels over 10.24 vertical divisions).

Input impedance – 50 Ω.

Between Channel Deskew – Range: 0 to 10 ns. Resolution: 1 ps.

ACQUISITION MODES

Normal – New data acquired on each sweep.

Envelope – Max/min values acquired over one or more acquisitions.

Average – Waveform averages selectable from 2 to 10000.

TIME BASE SYSTEM

Time Bases – Main, Delayed.

Time/Division Range – 20 ps/division to 2 ms/division in 1-2-5 steps or settable from the numeric keypad in 5 ps steps.

Delta Time Measurement Accuracy –

Time Interval	Accuracy
Ti≥ 1 ns	0.1% x interval +15 ps
100 ps	5 ps
10 ps	2 ps

Record Length – 500, 1000, 2000, and 5000, and 15,000 samples per channel.

Pre-Trigger View Time – 1.5 ns (TDS 820 only).

Minimum Trigger to Sample Delay: TDS 840 and TDS 820 with Opt. 1D – 16 ns.

TRIGGERING SYSTEM

Trigger Sources – External input, internal rate generator, CH 1, CH 2 (CH 1 and CH 2 sources not available with Opt. 1D or TDS 840).

External Trigger Sensitivity – 40 mVp-p from DC to 200 MHz, increasing linearly to 200 mVp-p at 2 GHz.

External Trigger Minimum Pulse Width – 0.25 ns.

Internal Trigger Sensitivity – 80 mVp-p from DC to 200 MHz, increasing linearly to 400 mVp-p at 1 GHz (Internal trigger source is not available with Opt. 1D or TDS 840).

Trigger Delay Jitter – 3 ps RMS + 30 ppm of time base delay.

Holdoff Range – 15 µs to 2 s.

DISPLAY

Waveform Style – Dots or vectors. Infinite and variable persistence from 250 ms to 10 s.

Gray Scaling – With variable persistence selected, waveform points gradually decay through 16 levels of intensity, providing "z-axis" information about rapidly changing waveforms.

Graticules – Full, grid, cross hair, frame.

Format – YT and XY.

CRT Type – 7 in. diagonal, magnetic deflection. Horizontal raster-scan. P4 White phosphor.

CRT Resolution – 640 horizontal by 480 vertical displayed pixels.

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

GPIB IEEE-488 — The TDS 820/840 complies with IEEE Standard 488.2-1987, and with Tektronix Standard Codes and Formats.

Digitizing Oscilloscopes

TDS 820
TDS 840

MEASUREMENT SYSTEM

Automatic Waveform Measurements –

Period	Frequency
High	Low
+ Width	– Width
Maximum	Minimum
Rise	Fall
Peak to Peak	Amplitude
+ Duty Cycle	– Duty Cycle
+ Overshoot	– Overshoot
Propagation Delay	Burst Width
Mean	Cycle Mean
RMS	Cycle RMS
Area	Cycle Area
+ Cross	– Cross

Continuous update of up to four measurements on any combination of waveforms.

Thresholds – Settable in percentage or voltage.

Cursor Measurements – Absolute, delta; Volts, Time, Frequency.

Cursor Types – Horizontal bars (volts); Vertical bars (time).

WAVEFORM PROCESSING

Waveform Functions – Interpolate-selectable sin(x)/x or linear, Average.

Arithmetic Operators – Add, Subtract, Multiply, Invert.

Autosetup – Single button, automatic setup on selected input signal for vertical, horizontal and trigger systems.

COMPUTER INTERFACE

GPIB (IEEE-488.2) Programmability – Full talk/listen modes. Control of all modes, settings, and measurements.

HARD COPY

Printer – HP Thinkjet, Epson, PostScript, Interleaf, Deskjet, Laserjet.

Plotter – HPGL.

Optional Hardcopy Interface – Centronics and RS-232C.

STORAGE

Waveforms – Up to 50,000 points.

Setups – 10 front panel setups.

POWER REQUIREMENTS

Line Voltage Range – 90 to 250 V RMS.

Line Frequency – 47 to 63 Hz.

Power Consumption – 250 Watts max.

ENVIRONMENT AND SAFETY

Temperature – Operating: 0 to +50°C. Non-operating: -40 to +75°C.

Humidity – Operating and non-operating: Up to 95% relative humidity at or below +40°C; to 75% relative humidity from +41 to 50°C.

Altitude – Operating: 15,000 ft., non-operating: 40,000 ft.

Electromagnetic Compatibility – Meets MIL-STD-461C, CE-03, Part 4, Curve # 1, RE-02, Part 7; meets VDE 0871, Category B, FCC rules and regulations, Part 15, Subpart J, Class A.

Safety – Listed UL 1244, CSA Bulletin 556B, Sept. 1973; Tektronix self-certification to comply with IEC 348 recommendations.

PHYSICAL CHARACTERISTICS

Dimensions	mm	in.
Height	164	6.5
w/ acc. pouch	177	7.0
Width	362	14.3
Depth w/front cover	491	19.3
Weight	**kg**	**lbs.**
Net	13.2	29.1
Shipping	23.6	52.0

ORDERING INFORMATION

TDS 820 – 2 Channel 6 GHz Digitizing Oscilloscope *1
Includes: 2 P6207 Probes; Reference (070-8511-00), User Manual (070-8512-00), Programmer Manual (070-8513-01), U.S. Power Cord (161-0230-01), two 12-inch 50 Ω Male-to-Male SMA Cable (174-1428-00), Antistatic Grounding Wrist Strap (006-3415-04), SMA "T" (015-1016-00), SMA Female-to-Female Adapter (015-1012-00), two SMA Short Circuit Male Terminations (015-1020-00), Front Cover (200-3696-00).

TDS 840 – 4 Channel 8 GHz Digitizing Oscilloscope *1
Includes: 4 P6207 Active Probes (4 GHz), Reference (070-8511-00), User Manual (070-8512-00), Programmer Manual (070-8513-01), U.S. Power Cord (161-0230-01), four 12-inch 50 Ω Male-to-Male SMA Cables (174-1364-00), 60-inch 50 Ω Male-to-Male SMA Cable (174-1428-00), Antistatic Grounding Wrist Strap (006-3415-04), SMA "T" (015-1016-00), SMA Female-to-Female Adapter (015-1012-00), four SMA Short Circuit Male Terminations (015-1020-00), Front Cover (200-3696-00).

Opt. 1D – (TDS 820 only) Delete Delay Lines ..... **–$450**
Opt. 2D – Delete 2 P6207 Probes *1
Opt. 4D – (TDS 840 only) Delete 4 P6207 Probes *1
Opt. 13 – RS232/CENTRONICS *1
Opt. 19 – (TDS 820 only) Add 2 P6206 Probes ..... **+$2,990*2**
Opt. 20 – Add 4 P6206 Probes *1
Opt. 22 – (TDS 820 only) Add 2 P6207 Probes ..... **+$5,360*2**
Opt. 23 – Add 4 P6207 Probes *1
Opt. 29 – (TDS 820 only) TD100 Data Manager ..... **+$2,495*2**
Opt. 1K – K218 Scope Cart ..... **+$695**
Opt. 1P – HC100 Plotter with Opt. 1 ..... **+$1,180**
Opt. 1R – Rack Mount ..... **+$400**
Opt. 9C – NIST & MIL STD-45552A Cal. certificate ..... **+$125**
Opt. B1 – Service Manual ..... **+$125**

INTERNATIONAL POWER PLUG OPTIONS
Opt. A1–A5 available.
See General Customer Information Section for description.

WARRANTY-PLUS SERVICE OPTIONS
Three years warranty, covering all labor and parts, including CRT, and excluding probes.

Opt. M2 – Repair Protection.
TDS 820 ..... **+$545**
TDS 840 ..... *1

Opt. M8 – Calibration Service.
TDS 820 ..... **+$750**
TDS 840 ..... *1

SOFTWARE – TD100 Data Manager. Order S34TDSL **$795**

PROBES
Active – 1 GHz, 2 pF/1MΩ, 1.7 m. Order P6206 ..... **$1,495**
4 GHz, 0.4 pF/100 kΩ, 1 m. Order P6207 ..... **$3,495**
Differential – 100 MHz, Active Differential, 6 ft. Order P6046 ..... **$2,195**
50 Ω Divider – Tips 1X, 10X. 9 GHz, 0.15 pF/500 Ω, 1 m. Order P6150 ..... **$995**
CARTS – TDS Scope TD100 with Keyboard Tray Order K220 and 436-0240-00 ..... **$775**

CAMERA/HARD COPY DEVICE
Camera – Order C9 with Opt. 1A and Opt. 05 ..... **$730**
Hood Adapter – Order 016-1145-00 ..... **$60**
Plotter – Order HC100 Opt. 01 ..... **$1,180**
Plotter Interface – GPIB, Centronics. Order 016-1145-00 ..... **$60**

ADDITIONAL ACCESSORIES
Security Cable – Order 012-1388-00 ..... **$42**
Soft-sided Carrying Case – Order 016-0909-00 ..... *1
With TD100/RIC386. Order 016-1095-00 ..... **$330**
Transit Case – With TD100/RIC386. Order 016-1135-00 ..... **$550**
Time to Voltage Converter – Requires TM 500/5000 Mainframe. Order TVC 501 ..... **$2,500**

**1 Contact your nearest Tektronix representative for price information.*

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

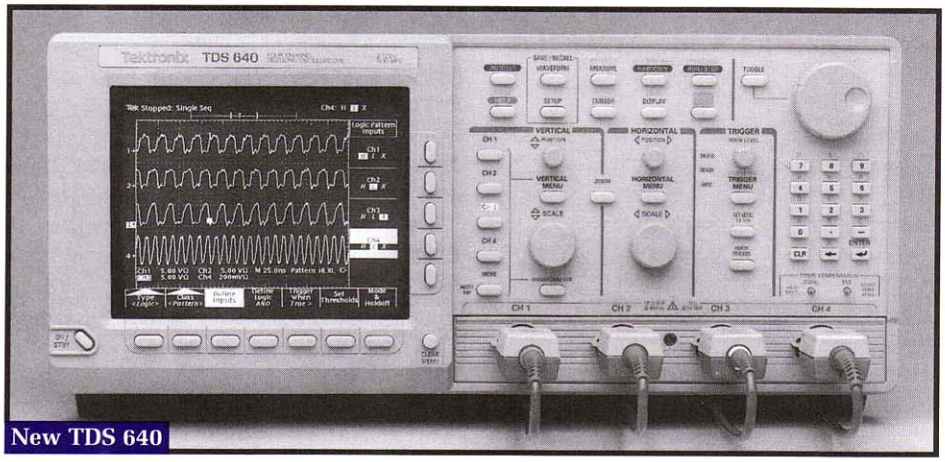
GPIB IEEE-488 — The TDS Series complies with IEEE Standard 488.2-1987, and with Tektronix Standard Codes and Formats.

TDS 520 / TDS 540 / TDS 620 / TDS 640 Digitizing Oscilloscopes

Designed to keep pace with evolving needs in digital design as well as manufacturing test, R&D and telecommunication applications.

TDS 520/TDS 540
TDS 620/TDS 640

- 500 MHz Bandwidth
- Sample Rates to 2 GS/s
- 2 and 4 Input Channels
- Time Interval, 2 ns Glitch, Runt, Pattern and State Triggering
- 1 mV/div to 10 V/div Sensitivity
- Infinite and Variable Persistence Displays
- Record Lengths to 50,000 Points
- 8 Bit Vertical Resolution and Up to 15 Bit Resolution with Hi-Res Acquisition Mode
- Vertical Accuracy to 1%
- FFT, Integration and Differentiation Option
- 25 Automatic Measurements
- 2 pF FET Probes Standard on TDS 600



New TDS 640

SIGNAL ACQUISITION SYSTEM

	TDS 520/620	TDS 540/640
Channels	2 + 2 auxiliary	4
Samplers	2	4
Bandwidth	500 MHz	500 MHz
Sensitivity		
CH 1, CH 2	1 mV to 10 V/div	1 mV to 10 V/div
CH 3, CH 4	NA	Same as CH 1 and CH 2
AUX 1, AUX 2 (TDS 520)	100 mV, 1.0 V, 10 V/div	NA
AUX 1, AUX 2 (TDS 620)	Same as CH 1 and CH 2	NA
Position Range	± 5 Divisions	± 5 Divisions
Offset		
CH 1, CH 2	±1 V from 1 to 99.5 mV/div	±1 V from 1 to 99.5 mV/div
AUX1, AUX2 (TDS 620)	±10 V from 100 mV to 995 mV/div ±100 V from 1 to 10 V/div	±10 V from 100 mV to 995 mV/div ±100 V from 1 to 10 V/div
CH 3, CH 4	NA	Same as CH 1 and CH 2
AUX 1, AUX 2 (TDS 520)	100 mV/div ±.5 V 1 V/div ±5.0 V 10 V/div ±50 V	NA

Maximum Sample Rate –

	TDS 520	TDS 540	TDS 620	TDS 640
Single Channel	500 MS/s	1 GS/s	2 GS/s	2 GS/s
Dual Channels	250 MS/s	500 MS/s	2 GS/s	2 GS/s
Four Channels	NA	250 MS/s	NA	2 GS/s

VERTICAL SYSTEM

DC Gain Accuracy – TDS 500 ±1.0%; TDS 600 ±1.5%.

Vertical Resolution – 8 bits (256 levels over 10.24 vertical divisions).

Analog Bandwidth Selections – 20 MHz, 100 MHz, and full (Except Aux 1 and Aux 2 on TDS 520 are full BW only).

Input Coupling – AC, DC or GND.

Input Impedance Selections – 1 MΩ in parallel with 10 pF, or 50 Ω (AC and DC coupling).

Maximum Input Voltage – ±400 V (DC + peak AC). Derate at 20 dB/decade above 1 MHz. 1 MΩ or GND coupled.

Channel Isolation – >100:1 at 100 MHz and >30:1 at bandwidth for any two channels having equal Volts/div settings.

AC Coupled Low Frequency Limit – ≤10 Hz when AC-1 MΩ coupled. ≤200 kHz when AC 50 Ω coupled.

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

GPIB IEEE-488 — The TDS Series complies with IEEE Standard 488.2-1987, and with Tektronix Standard Codes and Formats.

Digitizing Oscilloscopes

TDS 520 TDS 540 | TDS 620 TDS 640

TIME BASE SYSTEM

	TDS 520/540	TDS 620/640
Time Bases	Main, Delayed	Main, Delayed
Time/Division Range	500 ps to 10 s/div	500 ps to 5 s/div.
Time Base Accuracy	0.0025% over any interval ≥ 1 ms	0.01% over any interval ≥ 1 ms
Record Length	500 to 15000 pts. (50K pts optional)	500 to 2000 pts.
Pre-Trigger Position	0 to 100% of record	20% to 80% of record

TRIGGER TYPES

Edge (main and delayed)		Conventional level driven trigger. Positive or negative slope on any channel or rear panel auxiliary input (Except TDS 520). Coupling Selections: DC, AC, noise reject, HF reject, LF reject.
Pulse (main)	Width	Trigger on width of positive or negative pulse either within or not within selectable time limits. Time limits settable from 2 ns to 1 s.
	Glitch	Trigger on or reject glitches of positive, negative or either polarity. Minimum glitch width threshold is 2.0 ns, with 200 ps resolution.
	Runt	Trigger on a pulse that crosses one threshold but fails to cross a second threshold before returning across the first.
Logic (main)	Pattern	Specifies a logical combination (AND, OR, NAND, NOR) of the four input channels (Hi, Lo, Don't Care). Trigger when pattern stays True or False for user specified time.
	State	Any logical pattern of channels 1, 2 and 3 plus clock edge on channel 4. Triggerable on positive or negative clock edge.

ACQUISITION MODES

Peak Detect (TDS 520/540 only) – High frequency and random glitch capture. Captures glitches of 4 ns using acquisition hardware at all real-time sampling rates.

Sample – Sample data only.

Envelope – Max/min values acquired over one or more acquisitions.

Average – Waveform averages selectable from 2 to 10000.

Hi-Res (TDS 520/540 only) – Vertical resolution improvement and noise reduction on low-frequency signals, e.g. 15 bits at 5 ms/div and slower.

TRIGGERING SYSTEM

Triggers – Main, Delayed.

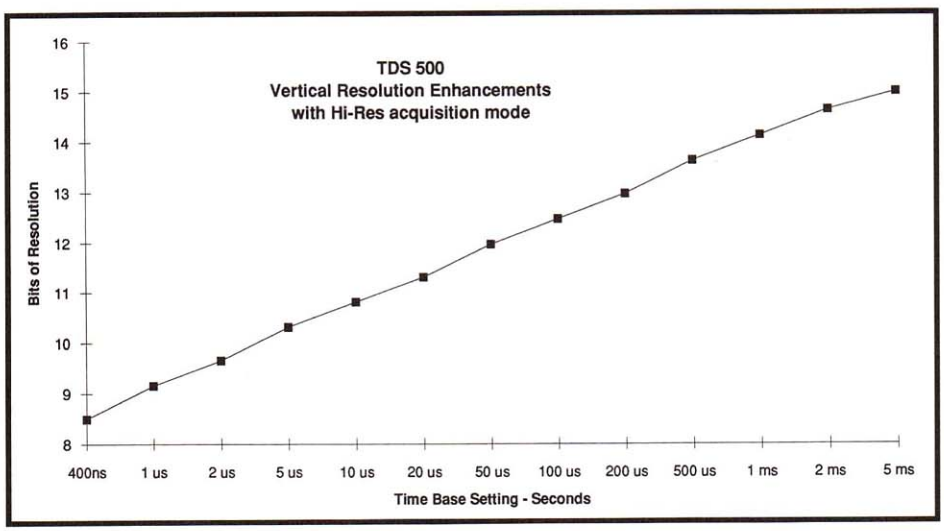
Main Trigger Modes – Auto, Normal, Single.

Delayed Trigger – Delayed by time and/or events.

Time Delay Range – 16 ns to 250 s (time/div ≤ 10 µs); 15.1 ns to 250 s (time/div ≥ 25 µs).

Events Delay Range – 1 to 9,999,999 events.

External Rear Input – (except TDS 520) >1.5 kΩ; Max input voltage is ±20 V (DC + AC peak).



DISPLAY

Waveform Style – Dots or vectors. Infinite and variable persistence selectable from 250 ms to 10 s.

Gray Scaling – With variable persistence selected, waveform points gradually decay through 16 levels of intensity, providing "z-axis" information about rapidly changing waveforms.

Update Rate – 200 waveforms per sec (TDS 500). 100 waveforms per sec (TDS 600). 500 point waveforms with infinite persistence display mode selected.

Graticules – Full, grid, cross hair, frame.

Format – YT and XY.

CRT Type – 7 in. diagonal, magnetic deflection. Horizontal raster-scan. P4 White phosphor.

CRT Resolution – 640 horizontal by 480 vertical displayed pixels.

ZOOM

The zoom feature allows waveforms to be expanded, compressed and positioned in both vertical and horizontal axes. Allows precise comparison and study of fine waveform detail without affecting ongoing acquisitions. When used with Hi-Res or Average acquisition modes, Zoom provides an effective vertical dynamic range of 1000 divisions or 100 screens.

MEASUREMENT SYSTEM

Automatic waveform measurements –

Period	Frequency
High	Low
+ Width	– Width
Maximum	Minimum
Rise	Fall
Peak to Peak	Amplitude
+ Duty cycle	– Duty cycle
+ Overshoot	– Overshoot
Propagation delay	Burst Width
Mean	Cycle Mean
RMS	Cycle RMS
Area	Cycle Area
Phase	

Continuous update of up to four measurements on any combination of waveforms.

Continued on next page.

TDS 520 TDS 540 TDS 620 TDS 640 Digitizing Oscilloscopes

Thresholds – Settable in percentage or voltage.

Gated – Any region of the record may be isolated for measurement using vertical bars.

Snapshot – Performs all measurements on any one waveform showing results from one instant in time.

Cursor Measurements – Absolute, delta; Volts, Time, Frequency.

Cursor Types – Horizontal bars (volts); Vertical bars (time); operated independently or in tracking mode.

WAVEFORM PROCESSING

Waveform Functions – Interpolate-selectable sin(x)/x or linear, Average, Envelope.

Optional Advanced Waveform Functions – FFT, Integration, Differentiation.

FFT – Frequency Range: DC to 500 MHz.
Amplitude Display: Power is dBV RMS, Linear RMS. Phase is degrees, radians.
Signal to Noise: 55 to 65 dB (Avg or HiRes).
Transform Size: 500 to 10,000 points selectable.
Windowing: Rectangular, Hamming, Hanning, Blackman – Harris.

Arithmetic Operators – Add, Subtract, Multiply, Invert.

Autosetup – Single button, automatic setup on selected input signal for vertical, horizontal and trigger systems.

Waveform Limit Testing – Compares incoming waveform to a reference waveform's upper and lower limits.

COMPUTER INTERFACE

GPIB (IEEE-488.2) Programmability – Full talk/listen modes. Control of all modes, settings, and measurements.

HARD COPY/DESKTOP PUBLISHING

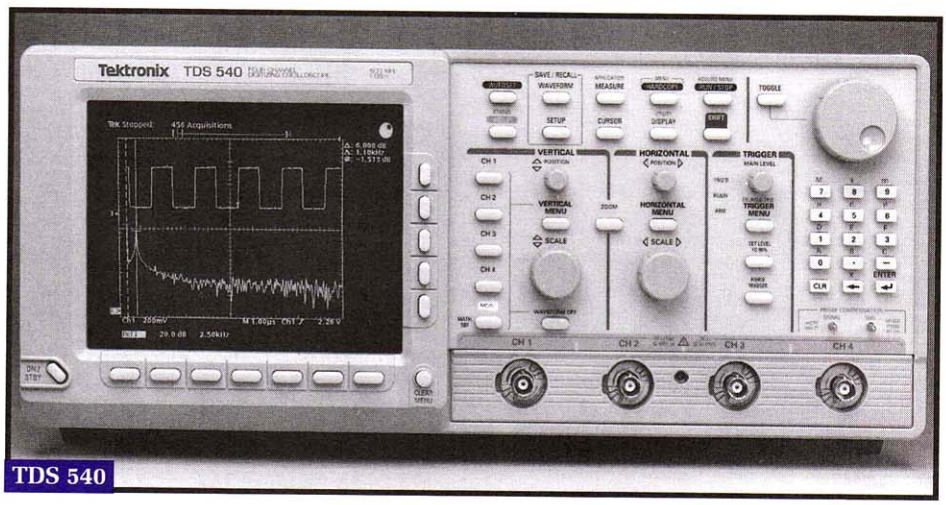
Printer – HP Thinkjet, Epson, PostScript, Deskjet, Laserjet.

Export File Formats – EPS(Encapsulated PostScript), Interleaf, TIFF, PCX, BMP.

Plotter Support – HPGL.

Standard Interface – GPIB.

Optional Hardcopy Interface – Centronics and RS-232C (Talk only).



TDS 540

STORAGE

Waveforms – (TDS 520/540) 4 full 5000 point records. 50,000 points total. (TDS 620/640) 4 full 2000 point waveforms.

Setups – 10 front panel setups.

POWER REQUIREMENTS

Line Voltage Range – 90 to 250 V RMS.

Line Frequency – 47 to 63 Hz.

Power Consumption – 300 Watts max.

ENVIRONMENTAL AND SAFETY

Temperature – Operating: 0 to +50°C. Nonoperating: -40 to +75°C.

Humidity – Operating and nonoperating: Up to 95% relative humidity at or below +40°C; to 75% relative humidity from +41 to +50°C.

Altitude – Operating: 14,000 ft., nonoperating: 40,000 ft.

Electromagnetic Compatibility – Meets MIL-STD-461C, CE-03, Part 4, Curve # 1, RE-02, Part 7; meets VDE 0871, Category B, FCC rules and regulations, Part 15, Subpart J, Class A.

Safety – Listed UL 1244, CSA Bulletin 556B, Sept. 1973; Tektronix self-certification to comply with IEC 348 recommendations.

PROBES

Active Probes – 10 x, 2 pF, 750 MHz FET (standard with TDS 600).

Passive Probes – 10 x, 8 pF, 500 MHz (standard with TDS 500).

PHYSICAL CHARACTERISTICS

Dimensions	mm	in.
Height with feet	236	9.3
without feet	193	7.6
Width with handle	445	17.5
Depth with front cover installed	432	17.0
Weight	**kg**	**lbs.**
Net ≈	12.3	27
Shipping ≈	20.0	44

Digitizing Oscilloscopes

TDS 520 | TDS 620
TDS 540 | TDS 640

ORDERING INFORMATION

TDS 520
2 Channel Digitizing Oscilloscope **$9,490**

TDS 540
4 Channel Digitizing Oscilloscope **$14,340**
Both include: 2 ea P6139A Probes (TDS 520); 4 ea P6139A Probes (TDS 540); Quick Reference Guide (070-8316-00); Tutorial/User Manual (070-8317-00); Programmer's Manual (070-8318-02); Front Cover (200-3696-00); U.S. Power Cord (161-0230-01)

TDS 620
2 Channel Digitizing Oscilloscope **$13,540**

TDS 640
4 Channel Digitizing Oscilloscope **$20,980**
Both include: 2 ea P6205 FET Probes (TDS 620); 4 ea P6205 FET Probes (TDS 640); Quick Reference Guide (070-8505-00); Tutorial/User Manual (070-8506-00); Programmer's Manual (070-8318-02); Front Cover (200-3696-00); U.S. Power Cord (161-0230-01)

Opt. 1K – K218 Scope Cart with Opt. 05 (No Power Strip) ..... **+$695**
Opt. 1M (TDS 520/540 only) – 50K Memory Length
TDS 520 ..... **+$1,500**
TDS 540 ..... **+$1,950**
Opt. 1P – HC100 4 pen plotter with Opt. 01 ..... **+$1,180**
Opt. 1R – Rack Mount ..... **+$400**
Opt. 2D (TDS 620 only) – Delete 2 ea P6205 Active Probes ..... **–$990**
Opt. 2F – Extended Waveform Math; FFT, Integration, Differentiation ..... **+$1,495**
Opt. 4D (TDS 640 only) – Delete 4 ea P6205 Active Probes .. **–$1,980**
Opt. 13 – Add RS-232C and Centronics Hardcopy Interfaces ... **+$495**
Opt. 9C – NIST and MIL-STD-45662A Calibration Certificate ... **+$125**
Opt. 22 (TDS 520/540 only) – Two Additional P6139A Probes ..... **+$500**
Opt. 23 (All except TDS 640) – Add 2 ea P6205 Active Probes ..... **+$990**
Opt. 24 (TDS 620/640 only) – Add 4 ea P6139A Probes ..... **+$1,000**
Opt. 29 – TD100 Data Manager ..... **+$2,495**
Opt. B1 – Module Level Service Manual ..... **+$125**

INTERNATIONAL POWER PLUG OPTIONS
Opt. A1 – Universal Euro 220 V, 50 Hz ..... **NC**
Opt. A2 – UK 240 V, 50 Hz ..... **NC**
Opt. A3 – Australian 240 V, 50 Hz ..... **NC**
Opt. A4 – North American 240 V, 60 Hz ..... **NC**
Opt. A5 – Switzerland 220 V, 50 Hz ..... **NC**
See General Customer Information Section for additional description.

WARRANTY-PLUS SERVICE OPTIONS
Three years warranty, covering all labor and parts, including CRT, and excluding probes.
Opt. M2 – Repair Protection.
TDS 520 ..... **+$595**
TDS 540 ..... **+$750**
TDS 620 ..... **+$710**
TDS 640 ..... **+$1,095**

Opt. M8 – Calibration Service.
TDS 520 ..... **+$290**
TDS 540 ..... **+$390**
TDS 620 ..... **+$370**
TDS 640 ..... **+$575**

SOFTWARE
TDS Data Manager Software – for TDS400, TDS500, TDS600 and TDS800 Scopes with Manual. For use on RIC386 and 2402A controllers or other DOS computers that have a National Instruments PCII/PCIIA GPIB cards. Does not support National Instrument PC-AT or PC-MC GPIB cards.
Order S34TDS1 ..... **$795**

PROBES
See Probe Section on page 423 for complete descriptions and full line of probes.
Active – 750 MHz, 2 pF/1 MΩ, 1.5 m. Order P6205 ..... **$495**
Differential – 100 MHz, Active Differential, 6 ft.
Order P6046 ..... **$2,195**
High Voltage –
100X, 120 MHz, 1500 V, 2.5 pF/10 MΩ, 9 ft. Order P6009 ..... **$265**
1000X, 75 MHz, 20 kV, 3.0 pF/100 MΩ, 10 ft. Order P6015A **$895**
General Purpose –
1X, 15 MHz, 54 pF/1 MΩ, 2m. Order P6101B **$60**
10X, 500 MHz, 8.0 pF/10 MΩ, 1.3m. Order P6139A **$250**
50 Ω Divider – 50 Ω Inputs, 2 Tips: 10X, 100X.
10X: 3.5 GHz, 1 pF/500 Ω, 1.5m;
100X: 3 GHz,1 pF/5000 Ω, 1.5m. Order P6156 with Opt. 25 ..... **$325**
Logic – 20 MHz, 17 bit, Word Recognizer/Trigger.
Order P6408 ..... **$425**
Micro/Fixed – See Probe Section, pages 440-441.
Spring Contact – See Probe Section, pages 440-441.
Current – (AC only), 120 Hz to 60 MHz, 7.5 A peak.
Order P6021 ..... **$545**
(AC only), 935 kHz to 120 MHz, 3 A peak. Order P6022 ..... **$595**
(DC & AC), DC-50 MHz System. Includes AM503A, A6302 20A probe, TM502A. Order AM503S **$2,595**
Carts – Order K218 ..... **$695**
TDS Scope with TDS100 – with Keyboard Tray.
Order K220 and 436-0240-00 ..... **$775**

CAMERAS/HARD COPY DEVICE
Camera – Order C-9 with Opt 05 and Opt. 1A **$710**
Hood Adapter – Order 016-1145-00 ..... **$60**
Plotter – with GPIB and Centronics Interface.
Order HC100 with Opt. 01 ..... **$1,180**

ADDITIONAL ACCESSORIES
Security Cable – Order 012-1388-00 ..... **$42**
Soft-sided Carrying Case
TDS 500,600,800. Order 016-0909-00 ..... ***1**
With TD100/RIC386. Order 016-1095-00 ..... **$330**
Transit Case – With TD100/RIC386. Order 016-1135-00 ..... **$550**

**1 Contact your local Tektronix representative for price information.*

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

GPIB IEEE-488 — The TDS Series complies with IEEE Standard 488.2-1987, and with Tektronix Standard Codes and Formats.

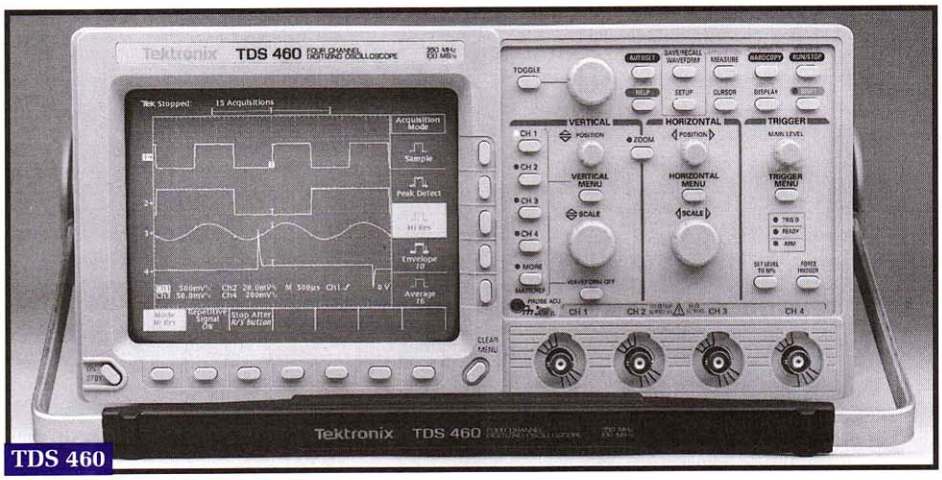
TDS 420
TDS 460

Digitizing Oscilloscopes

Ideal for digital, analog and video circuit design; electro-mechanical research; electronic product service and manufacturing test.

TDS 420/TDS 460

- 150 and 350 MHz Bandwidths
- 100 MS/s Sampling Rate on 4 Channels
- 1 mV/div to 10 V/div Sensitivity
- 10 ns Peak Detect Mode for High Speed Glitch Capture
- 8 Bit Vertical Resolution
- Hi-Res Mode for up to 15 Bits of Vertical Resolution
- Infinite and Variable Persistence Displays
- 1.5% Vertical Accuracy
- 22 Automatic Measurements



TDS 460

SIGNAL ACQUISITION SYSTEM

Bandwidth – 150 MHz (TDS 420), 350 MHz (TDS 460).

Channels – 4.

Digitizers – 4.

Sample Rate – 100 MS/sec on all channels.

Sensitivity – 1 mV to 10 V/div (with calibrated fine adjust).

Position Range – ± 5 Divisions.

Offset Range – ±1 V from 1 to 99.5 mV/div; ±10 V from 100 mV to 995 mV/div; ±100 V from 1 to 10 V/div.

DC Gain Accuracy – ±1.5%.

Vertical Resolution – 8 bits (256 levels over 10.24 vertical divisions).

Analog Bandwidth Selections – 20 MHz, 100 MHz, and full.

Input Coupling – AC, DC or GND.

Input Impedance Selections – 1 MΩ in parallel with 15 pF, or 50 Ω (AC and DC coupling).

Maximum Input Voltage – ±400 V (DC + peak AC). Derate at 20 dB/decade above 1 MHz. 1MΩ or GND coupled.

Channel Isolation – >100:1 at 100 MHz for any two channels.

AC Coupled Low Frequency Limit – ≤10 Hz when AC 1 MΩ coupled. ≤200 kHz when AC 50 Ω coupled.

ACQUISITION MODES

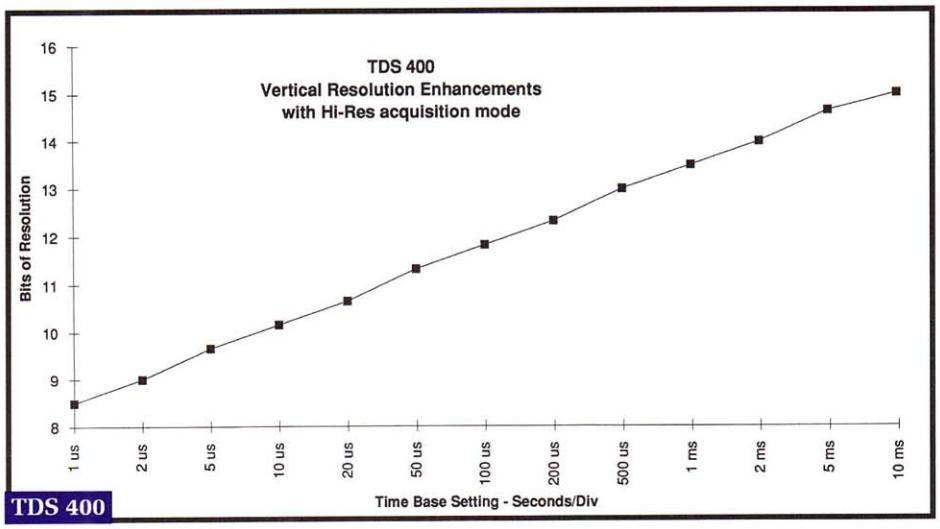
Peak Detect – High frequency and random glitch capture. Captures glitches of 10 ns using acquisition hardware at all real-time sampling rates.

Sample – Sample data only.

Envelope – Max/min values acquired over one or more acquisitions, selectable from 2 to 2000, infinite.

Average – Waveform averages selectable from 2 to 10000.

Hi-Res – Vertical resolution improvement and noise reduction on low-frequency signals, e.g.15 bits at 10 ms/div and slower.



TDS 400

TD

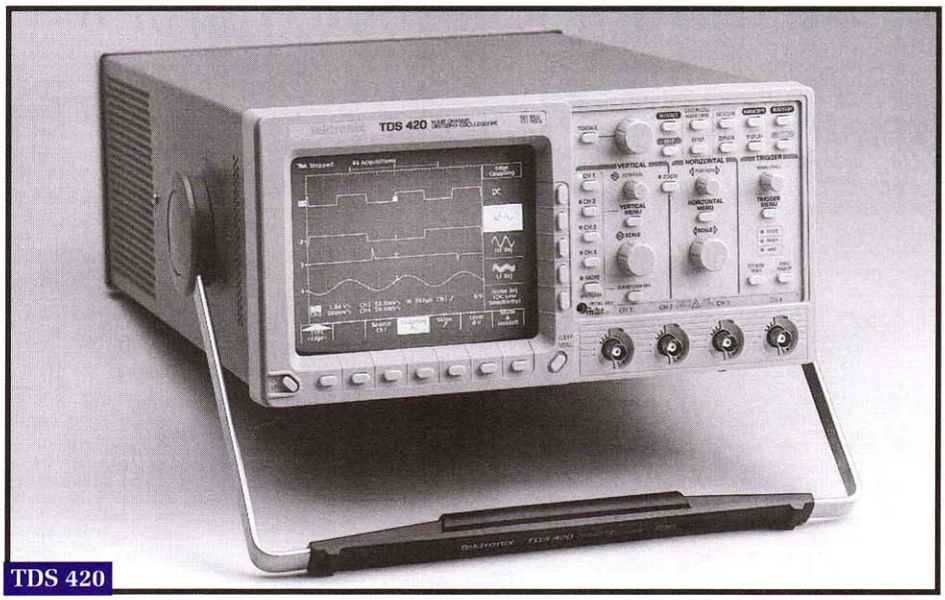
Product also available within 24 hours through TekDirect. Call 1-800-426-2200

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

GPIB IEEE-488 — The TDS Series complies with IEEE Standard 488.2-1987, and with Tektronix Standard Codes and Formats.

Digitizing Oscilloscopes

TDS 420
TDS 460



TDS 420

TIME BASE SYSTEM
Time Bases – Main, Delayed.

Time/Division Range – 1 ns to 20 s/div.

Time Base Accuracy – 0.005% over any interval ≥1 ms.

Record Length (real time and equivalent time) – Sample points per channel: 500 to 5,000. Opt. 1M offers 30,000 points.

Pre-Trigger Position – Selectable from 0 to 100% of record.

TRIGGERING SYSTEM
Triggers – Main, Delayed.

Main Trigger Modes – Auto, Normal.

Delayed Trigger – Delayed by time or events.

Time Delay Range – 0 ns to 20 s.

Events Delay Range – 2 to 10,000,000 events.

External Rear Input – > 1.5 kΩ; Max input voltage is ±6 V (DC + AC peak).

Video Trigger Types – NTSC, PAL, SECAM, and Custom; TV Field, field 2 or both, Any line within a field. Line Rates–10 kHz to 64 kHz, interlaced, non-interlaced, composite.

Video Trigger Sensitivity – 0.5 divisions of composite synch will achieve a stable display.

DISPLAY
Waveform Style – Dots or vectors. Infinite and variable persistence from 250 ms to 10 s.

Gray Scaling – With variable persistence selected, waveform points gradually decay through 16 levels of intensity, providing "z-axis" information about rapidly changing waveforms.

Update Rate – 200 ea 500 point waveforms per sec with infinite persistence mode selected.

Graticules – Full, grid, cross hair, frame.

Format – YT and XY.

VGA Out – Drives VGA display monitors.

ZOOM
The zoom feature allows waveforms to be expanded, compressed and positioned in both vertical and horizontal axes. Allows precise comparison and study of fine waveform detail without affecting ongoing acquisitions. When used with Hi-Res or Average acquisition modes, Zoom provides an effective vertical dynamic range of 1000 divisions or 100 screens.

MEASUREMENT SYSTEM
Automatic waveform measurements –

Period	Frequency
High	Low
+ Width	- Width
Maximum	Minimum
Rise	Fall
Peak to Peak	Amplitude
+ Duty cycle	- Duty cycle
+ Overshoot	- Overshoot
Propagation delay	Burst Width
Mean	Cycle Mean
RMS	Cycle RMS

Continuous update of up to four measurements on any combination of waveforms.

Thresholds – Settable in percentage or voltage.

Cursor Measurements – Absolute, delta, Volts, Time, Frequency.

Cursor Types – Horizontal bars (volts); Vertical bars (time).

WAVEFORM PROCESSING
Waveform Functions – Interpolate-selectable sin(x)/x or linear.

Arithmetic Operators – Add, Subtract, Multiply, Invert.

Autosetup – Single button, automatic setup on selected input signal for vertical, horizontal and trigger systems.

COMPUTER INTERFACE
GPIB (IEEE-488.2) Programmability – Full talk/listen modes. Control of all modes, settings, and measurements.

HARD COPY/DESKTOP PUBLISHING
Printer – HP Thinkjet, Epson, PostScript, Deskjet, Laserjet.

Plotter – HPGL.

Standard Interface – GPIB.

Export File Formats – EPS (Encapsulated PostScript), Interleaf.

STORAGE
Waveforms – 60,000 waveform points of non-volatile storage.

Setups – 10 front panel setups.

CRT
Type – 7 in. diagonal, magnetic deflection. Horizontal raster-scan. P31 green phosphor.

Resolution – 640 horizontal by 480 vertical displayed pixels.

POWER REQUIREMENTS
Line Voltage Range – 90 to 250 V RMS.

Line Frequency – 47 to 63 Hz.

Power Consumption – 250 Watts max.

Continued on next page.

Digitizing Oscilloscopes

ENVIRONMENTAL & SAFETY

Temperature – Operating: 0 to +50°C. Nonoperating: -40 to +75°C.

Humidity – Operating and nonoperating: Up to 95% relative humidity at or below +40°C; to 75% relative humidity from +41 to +50°C.

Altitude – Operating: 15,000 ft., nonoperating: 40,000 ft.

Electromagnetic Compatibility – Meets MIL-STD-461C, CE-03, Part 4, Curve # 1, RE-02, Part 7; meets VDE 0871, Category B, FCC rules and regulations, Part 15, Subpart J, Class A.

Safety – Listed UL 1244, CSA Bulletin 556B, Sept. 1973; Tektronix self-certification to comply with IEC 348 recommendations.

PHYSICAL CHARACTERISTICS

Dimensions	mm	in.
Height	164	6.4
w/acc. pouch	177	7.5
Width	362	14.25
Depth w/front cover installed	491	19.25
w/handle extended	576	22.2
Weight	**kg**	**lbs.**
Net ≈	9.1	22.5
Shipping ≈	12.5	32

ORDERING INFORMATION

TDS 420
4 Channel Digitizing Oscilloscope ..... TD **$5,595**

TDS 460
4 Channel Digitizing Oscilloscope ..... TD **$7,495**

Both include: Probe (2 P6138 10X Passive Probes); Quick Reference Guide (070-8035-00); Tutorial/User Manual (070-8034-00); Programmer's Manual (070-8318-01); U.S. Power Cord (161-0230-01).

Opt. 02 – Front Cover and Accessories Pouch ..... **+$60**
Opt. 05 – VideoTrigger ..... TD **+$995**
Opt. 1K – K212 Scope Cart ..... **+$395**
Opt. 1M – 30,000 Point Record Length ..... TD **+$995**
Opt. 2A – VideoTrigger and 30,000 Point Record Length ..... TD **+$1,500**
Opt. 1P – HC100 4 Pen Plotter ..... **+$1,180**
Opt. 1R – Rack Mount ..... **+$350**
Opt. 22 – Two additional P6138 Probes ..... **+$350**
Opt. 23 – Two P6205 FET Probes ..... **+$990**
Opt. 9C – NIST and MIL-STD-45662A Calibration Certificate ..... **+$125**
Opt. B1 – Module Level Service Manual ..... **+$125**

INTERNATIONAL POWER PLUG OPTIONS
Opt. A1 – Universal Euro 220 V, 50 Hz ..... **NC**
Opt. A2 – UK 240 V, 50 Hz ..... **NC**
Opt. A3 – Australian 240 V, 50 Hz ..... **NC**
Opt. A4 – North American 240 V, 60 Hz ..... **NC**
Opt. A5 – Switzerland 220 V, 50 Hz ..... **NC**

See General Customer Information Section for additional description.

WARRANTY-PLUS SERVICE OPTIONS
Three years warranty, covering all labor and parts, including CRT, and excluding probes.

Opt. M2 – Repair Protection.
TDS 420 ..... **+$495**
TDS 460 ..... **+$545**

Opt. M8 – Calibration Service.
TDS 420 ..... **+$290**
TDS 460 ..... **+$290**

SOFTWARE
TDS Data Manager Software – for TDS400, TDS500, TDS600 and TDS800 Scopes with Manual. For use on RIC386 and 2402A controllers or other DOS computers that have a National Instruments PCII/PCIIA GPIB cards. Does not support National Instrument PC-AT or PC-MC GPIB cards.
Order S34TDS1 ..... **$795**

PROBES
See Probe Section on page 423 for complete description and full line of probes.

Active – 750 MHz, 2 pF/1 MΩ, 1.5 m. Order P6205 ..... **$495**

Differential –
100 MHz, Active Differential, 6 ft. Order P6046 ..... **$2,195**

High Voltage –
100X, 120 MHz, 1500 V, 2.5 pF/10 MΩ, 9 ft. Order P6009 ..... **$265**
1000X, 75 MHz, 20 kV, 3.0 pF/100 MΩ, 10 ft. Order P6015A **$895**

General Purpose –
1X, 15 MHz, 54 pF/1 MΩ, 2m. Order P6101B **$60**
10X, 350 MHz, 10.0 pF/10 MΩ, 1.3m. Order P6138 ..... **$175**

50 Ω Divider – 50 Ω Inputs, 2 Tips: 10X, 100X.
10X: 3.5 GHz, 1 pF/500 Ω, 1.5m 100X: 3 GHz,1 pF/5000 Ω, 1.5m. Order P6156 with Opt. 25 ..... **$325**

Logic – 20 MHz, 17 bit, Word Recognizer/Trigger.
Order P6408 ..... **$425**

Micro/Fixed – See Probe Section, pages 440-441.

Spring Contact – See Probe Section, pages 440-441.

Current –
(AC only), 120 Hz to 60 MHz, 7.5 A peak. Order P6021 ..... **$545**
(AC only), 935 Hz to 120 MHz, 3 A peak. Order P6022 ..... **$595**
(DC & AC), DC-50 MHz System, includes AM503A, A6302 20A probe. Order AM503S **$2,595**

Carts – Order K212 ..... **$395**

TDS Scope with TD100 – With Keyboard Tray.
Order K220 and 436-0240-00 ..... **$775**

CAMERAS/HARD COPY DEVICE
Camera – Order C9 with Opt. 1A and Opt. 04 ..... **$730**
Hood Adapter – Order 016-1154-00 ..... **$60**
Plotter – with GPIB and Centronics Interface.
Order HC100 with Opt. 01 ..... **$1,180**

ADDITIONAL ACCESSORIES
Security Cable – Order 012-1388-00 ..... **$42**

TD
Product also available within 24 hours through TekDirect. Call 1-800-426-2200

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

GPIB IEEE-488 — The TDS Series complies with IEEE Standard 488.2-1987, and with Tektronix Standard Codes and Formats.

Software and Mass Storage

TDS500/TD100

TDS540 Oscilloscope with TD100 installed. TD100 may be ordered as Opt. 29.

Data Management Solutions

The Tektronix TDS Series oscilloscopes can record (store in local memory) a host of data types including waveforms, front panel setups and menu images.

The S34TDS1 Data Manager is a time-saving software package that automates several key functions of the Tektronix TDS Series oscilloscopes. It can be used in any PC-compatible computer equipped with an appropriate GPIB interface, or in one of several Tektronix controllers including the TD100, RIC 386, and 2402A.

TURNING THE TDS INTO A MEASUREMENT SYSTEM

Because the Data Manager software was conceived as an adjunct to the TDS products, it achieves the efficiencies of a fully integrated tool. A TDS scope outfitted with S34TDS1 software is a compact, powerful measurement system that solves real-world test problems: it saves time in setup procedures, and ensures that measurements are made to the same standards every time; it expedites storage of acquired waveforms; it reduces the demand on the operator (less -skilled personnel can make complex measurements); it provides for unattended waveform recording of any event that triggers the TDS scope itself.

The Data Manager builds on the TDS' hardware strengths. It uses the scope's own screen display and soft keys as its user interface. Prompts and menus are viewed on the scope's CRT screen, and responses entered with the front panel keys in the same way that one operates the TDS itself. As a result, there is no separate "learning curve" for the Data Manager functions; anyone who knows how to run a TDS scope can operate the software.

ANALYZE STORED WAVEFORM DATA EASILY

Data Manager software takes the complexity out of measurement data analysis. Waveforms can be stored on disk in a variety of formats including one readable by conventional spreadsheet programs like Microsoft Excel® and LOTUS 1-2-3®.

STORED SETUPS SPELL CONSISTENCY

Stored scope front-panel passed "from hand to hand," seeing many tests and users each week. By recalling stored setups, each operator has immediate access to the exact control settings he or she last used. This guarantees consistency from day to day and ensures repeatable test results.

Continued on next page.

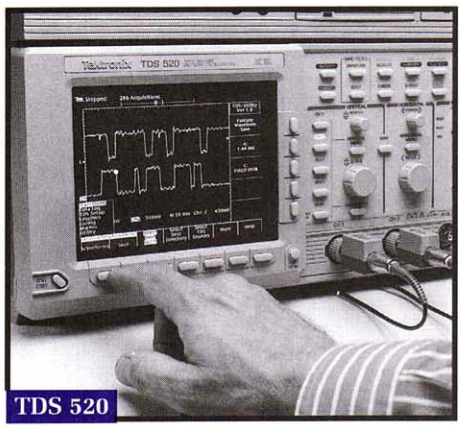
TD100

- Save and Recall Waveform Data and Setups
- Easy Graphic Image Capture for Desktop Publishing
- Macros Automate Data Management Operations
- Disk Utilities to Format Data Disks and Copy Files
- Available as Standalone Software or Bundled with Hardware Packages for the TDS400, 500, 600, and 800 Series Oscilloscopes

Data management solutions for Tektronix TDS Series Oscilloscopes.

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

Software and Mass Storage



TDS 520

UNATTENDED WAVEFORM DATA LOGGING

The TDS oscilloscopes are known for their wealth of triggering options. The Data Manager software permits unattended recordings of any glitches, digital pattern combinations, or edges that trigger the TDS scope. In addition, the Data Manager software can log any event that falls outside a preset waveform template (Envelope limit testing).

GRAPHICS IMAGE CAPTURE

The Data Manager software expedites desktop publishing of screen images with its ability to store images in industry-standard graphic formats: EPS, HPGL, TIFF, and Interleaf. These formats are compatible with established PC illustration and desktop publishing applications, meaning that they can be imported "as is" (no filters or conversions required) and placed directly into the finished document.

MACROS

The Data Manager software's macro capability automates repetitive control operations. A procedure that normally requires several keystroke responses, such as setting up the scope, initiating datalogging, and assigning a datalog disk, can be condensed into a single keystroke (macro).

DISK AND FILE UTILITIES

The Data Manager software supports the full repertoire of disk- and file-handling utilities needed for mass storage applications. Again, these functions are activated from the TDS front panel soft keys.

TD100 DATA MANAGER

The TD100 is a low-cost dedicated Data Manager for the TDS500, 600 and 800 Series Digital Storage Oscilloscopes. It comes preconfigured with the S34TDS1 Data Manager software and mechanically docks to the body of the TDS, creating an integrated, self-contained system. The TD100 includes a 40 Mbyte hard disk as well as an DOS-compatible 1.44 Mbyte 3-1/2 inch floppy disk.

SUMMARY

With the addition of the S34TDS1 Data Manager software, the TDS oscilloscope becomes a powerful waveform acquisition and storage system that supports many users, short- or long-term data logging and desktop publishing. The TD100 Data Manager, RIC386 controller, and 2402A controller provide an ideal hardware environment for the Data Manager software, or the package may be used with a conventional PC-compatible external computer.

In any environment, the Data Manager solution dramatically reduces the time and effort needed to store and manipulate TDS scope operations.

ORDERING INFORMATION

TD100
TD100 Data Manager for TDS500, TDS600, and TDS800 Digital Storage Oscilloscopes **$2,495**
Includes: 40 Mbyte Hard Disk, 1.44 Mbyte Floppy Drive, IEE488.1 Port, Hardware Manual, TDS Scope Mounting Hardware, 1/2 meter GPIB Cable and TDS Data Manager Software.
Opt. 29 – With TDS500, TDS600 or TDS800 ..... **+$2,495**

S34TDS1
TDS Data Manager Software for TDS400, TDS500, TDS600, and TDS800 Scopes with Manual. For use on RIC386 and 2402A Controllers or other DOS computers that have a National Instruments PCII/PCIIA GPIB cards. Does not support National Instrument PC-AT or PC-MC GPIB cards. **$795**

ADDITIONAL ACCESSORIES
Hard Shell Carrying Case – (For TD100/RIC386) mounted on TDS Scope. Order 016-1135-00 ..... **$550**
Soft Shell Carrying Case – (For TD100/RIC386) mounted on TDS Scope. Order 016-1095-00 ..... **$330**
K220 Instrument Cart – With available Keyboard Tray. Order K220 and 436-0240-00 ..... **$775**

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

11000, DSA, CSA Series Digitizing Oscilloscopes

11000 Series

The Tektronix 11000 Series is a powerful set of analysis tools that alters your fundamental expectations of an oscilloscope. Most revolutionary is the simplification and automation of the entire measurement and analysis process. Accuracy, sensitivity, bandwidth, offset, and overdrive recovery are provided by a well-planned instrument family having plug-in versatility and performance. Multi-processor architecture allows for simultaneous display of up to eight waveforms and up to six dynamic, "live" measurement readouts. The automation needs of scientific and production environments are easily met by integrating these instruments into a measurement system through RS-232-C or GPIB interfaces.

DSA Series

The Digitizing Signal Analyzer (DSA) Series incorporates a dedicated digital signal processor (DSP) making it the most powerful instrument in the 11000 Series. The power of this new class of instrument is two-fold: it provides the fastest and most accurate real-time digitizer and it provides signal processing capability previously found only in large computer systems. The dedicated DSP allows simultaneous real-time FFT and time domain display, fast averaging at 180 waveforms/second, signal dejitter, and much more.

CSA Series

The Communications Signal Analyzer (CSA) Series offers signal analysis and the powerful measurement capabilities required to analyze high-speed digital, communication signals. Features of the CSA 803 and CSA 404 include histograms, mask testing, and a color-graded display; allowing you to perform accurate measurements such as jitter, noise, and phase.

11000, DSA, CSA SERIES SELECTION GUIDE

11400 Series	High Accuracy	11403A 11402A
11800 Series	High Bandwidth, High Accuracy	11801A
CSA Series	High Speed, Digital/Optical, Communications	CSA 803 CSA 404
DSA Series	High Speed Single Shot w/DSP	DSA 601A DSA 602A

CONTENTS

11000 SERIES OSCILLOSCOPES/PLUG-INS

11402A – 1 GHz Monochrome.....72
11403A – 3 GHz Color.....72
11000/DSA Series Plug-in Amplifiers.....78
11801A 12.5 to 50 GHz Digital Sampling.....86

DSA SERIES DIGITIZING SIGNAL ANALYZER

DSA 602A – 1 GHZ.....68
DSA 601A – 1 GHZ.....68

CSA SERIES COMMUNICATIONS SIGNAL ANALYZERS

CSA 404 Up to 50 GHz.....246
CSA 803 Up to 50 GHz.....250
CSA 907A Bit Error Rate Tester.....254

11000 Series

DSA Series CSA Series

High Performance Digitizing Oscilloscopes

A technology for every application.

11400A SERIES
- 3 GHz Bandwidth
- 10 Bit Vertical Resolution
- Up to 12 Acquisition Channels
- Powerful Processing

11801A
- DC to 50 GHz Bandwidth (7 ps Risetime)
- 8 Channels, Expandable to 136
- Automatic Statistical Measurements, Histograms and Mask Testing
- Modular Architecture

DSA 600A SERIES
- 1 GHz Bandwidth
- 2 GS/s Single Shot Acquisition
- Fast & Extensive Signal Processing

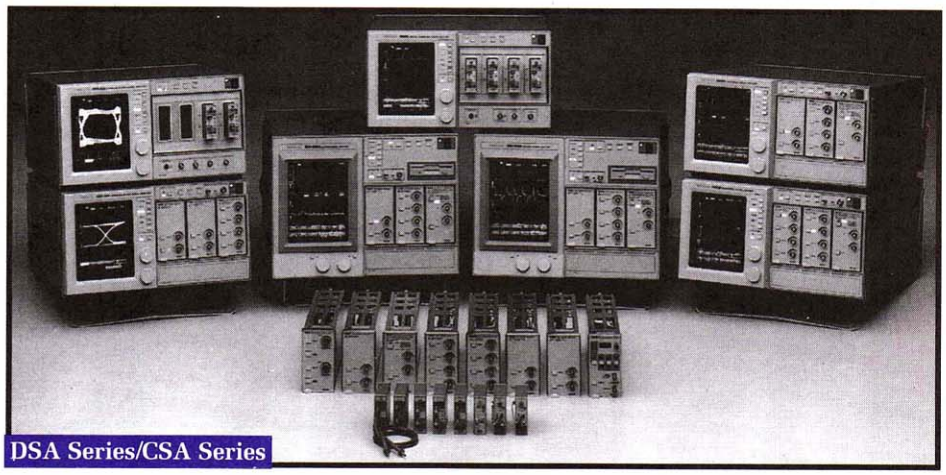
CSA 404
- Choice of Bandwidths through Modularity
- CSA 404: DC to 150, 300, 400, 600 MHz
- Trigger to 2 GHz with the 11A81 Amplifier

CSA 803
- High Resolution and Repeatability
- 8.8 ps Risetime
- Automatic Analysis
- Modularity Through Sampling Heads

CSA 907A
- SDH/ SONET and FDDI Pattern Generation
- 150 kHz to 700 MHz Internal PLL Clock Source
- PRBS Patterns: $2^{(7,15,17,20,23)}-1$
- Optional 128K Bit Programmable Word Memory
- PC Based Frame Editing Software for Added Versatility

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

GPIB IEEE-488 — The 11000, DSA, CSA Series comply with IEEE Standard 488.1-1987, RS-232-C, and with Tektronix Standard Codes and Formats.



DSA Series/CSA Series

11400A Series

The 11400A Series Digitizing Oscilloscopes use Random equivalent-time sampling technology to digitize and display repetitive signals with up to 14-bit resolution and 1% vertical accuracy.

Continuously updated measurements and statistics provide the confidence required in automated test environments.

11801A

The 11801A uses sequential equivalent-time sampling technology to achieve bandwidths of up to 50 GHz. Sampling head modularity provides a variety of acquisition methods including TDR, optical coupling, loopthrough sampling, low-noise sampling, triggering, and probe sampling.

Up to 136 channels of acquisition and TDR measurements can be achieved with an 11801A. The 11801A provides the highest timing resolution and measurement repeatability of any of the 11000 Series.

DSA 600A Series

Providing real-time digitizing at 2 GS/s, the Digitizing Signal Analyzers are the most powerful members of the 11000 Series. These instruments contain a dedicated digital signal processor that processes waveforms at unprecedented speeds.

The DSA offers live FFT, signal dejitter, fast averaging at more than 180 waveforms per second, and more. For the highest level of performance in single-shot acquisition and signal processing, the DSA Series provides the measurement solution.

CSA 404 and CSA 803

The CSA 404 and CSA 803 Communications Signal Analyzers are designed for viewing communication signals up to 50 GHz.

Histogram, masking testing, and a color graded display are included to form an ideal tool for analyzing eye diagrams.

CSA 907A

The CSA 907A Bit Error Rate Tester is a stimulus-response system that features a high-speed serial pattern generator, the CSA 907A TX, and a companion error detector, the CSA 907A Rx. Each unit is portable, and can be used in a lab, production testing, or field environment. The CSA 907A Bit Error Rate Tester can be used to evaluate transmission quality of high speed modules and systems for a variety of testing applications including SDH/SONET, FDDI, and satellite communications.

Accuracy

Measurement accuracy sets the 11000 Series apart from all other oscilloscopes. The analog input circuitry is the most advanced in any oscilloscope – digital or analog. The plug-in amplifiers are built to maintain signal integrity over a wide dynamic range. The 11000 Series delivers accuracy across widely varying conditions of signals and settings: you don't have to worry about whether you're viewing your signal or seeing the oscilloscope's amplifier anomalies.

The Enhanced Accuracy feature of the 11000 Series provides worry-free and effortless automatic internal calibration of the instrument. The instruments continually monitor themselves for accuracy.

High Performance Digitizing Oscilloscopes

Flexibility and Power

The 11000 Series continues the plug-in versatility of the Tektronix 7000 Series. Nine plug-in amplifiers, ten sampling heads, and a variety of probes are currently available to tailor a signal conditioning solution to your measurement needs.

Whether it is multi-channel (up to 136), 50 Ω/1 MΩ inputs, differential, high bandwidth or optical, the 11000 Series of oscilloscopes offer more versatility than any other oscilloscope. No other oscilloscope can provide the performance, accuracy, sensitivity, bandwidth, filtering, offset, or overdrive recovery of the 11000 Series amplifiers and probes.True dual time bases let you view portions of a waveform at much higher resolution than the main trace. This provides measurement flexibility and improved accuracy. Record lengths (up to 32K points in the DSA 600A) can be specified separately for main waveforms and window waveforms, as the application dictates. Two windows allow you to view and measure two separate events at fast sweep speed, improving the accuracy of measurements of those events.

The DSA 600A Series uses the Tektronix TriStar Digital Signal Processor (DSP). These processors provide unsurpassed signal acquisition and analysis. This not only yields very fast waveform update rates, but also provides the power to define and display, at "live" speeds new waveforms based on complex mathematical relationships to other waveforms. Nowhere else will you find this power and flexibility.

The CSA 803 and CSA 404 offer histograms and mask testing to specifically perform the measurements on signals that are typical in communication applications. Histograms are powerful measurement tools for measuring jitter and noise. Mask testing is a very beneficial tool in ATE applications for measuring noise margin and jitter tolerance.

Digital Signal Processing

The 11000 Series provides capability far beyond the basic four math functions of +, −, x, and ÷. It also provides more complex waveform processing such as differentiation, integration, square root, logarithms, and more. In all, more than 10 different signal processing options are available. The DSA 600A Series with its TriStar Digital Signal Processor provides 14 different options; including averaging at 180 waveforms per second, signal dejitter, "live" FFT, and single-shot smoothing.

The architecture has the power to display these defined waveforms in real time and make measurements directly on the complex waveforms.

Automation

Each 11000 Series Oscilloscope provides both RS-232-C and IEEE 488 Standard interfaces. The 11000 Series provides ideal solutions both for low-cost benchtop automation and for rack-mount production applications.

Tektronix offers several compatible software packages to support the 11000 Series in scientific and production applications. Scientists will find that the series is supported by many of the most popular controllers and software packages. Template software from Tektronix supports both process and production environments.

Hard Copy Support

You can also print date and time stamped copies of the screen at the push of a button or a bus command, using Tektronix color printers, Tektronix HC100 plotter, Epson printer, Centronics printer, HP Inkjet/Laserjet printers or HPGL plotters. Support for electronic import of hardcopies is also provided.

11000 SERIES SELECTION GUIDE

Instrument	Bandwidth	Maximum # of Channels	Sample Rate	Maximum Record Length	Vertical Resolution	Digitizing Technology
DSA 601A	1 GHz	12	1 GS/s	20K	8 bits	Real Time
DSA 602A	1 GHz	12	2 GS/s	3K	8 bits	
11801A	50 GHz	136	200 kS/s	5K	8 bits	Sequential
CSA 803	50 GHz	4	200 kS/s	5K	8 bits	Equivalent Time
11403A/CSA 404	3 GHz	12	20 MS/s	10K	10 bits	Random
11402A	1 GHz	12	20 MS/s	10K	10 bits	Equivalent Time

DSA 601A
DSA 602A

Digitizing Signal Analyzers

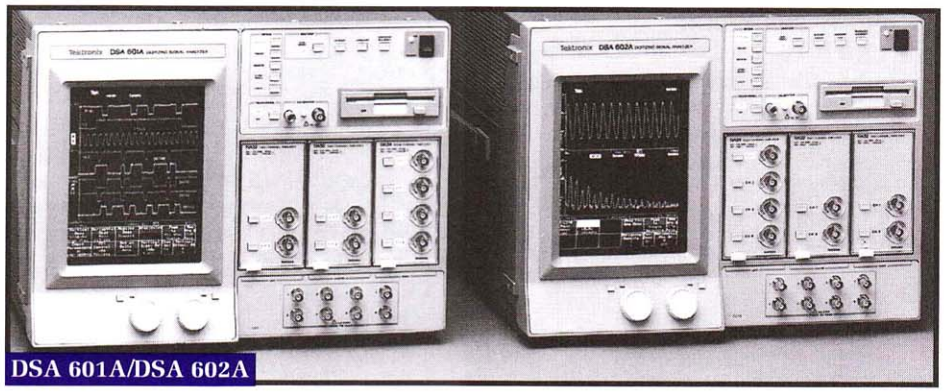
The DSA 600A Series Analyzers provide the ultimate combination of signal acquisition, processing and display performance for repetitive and highspeed transient-capture applications.

DSA 601A/602A

- 1 GHz Bandwidth
- 1 mV/Div to 10 V/Div
- 2 GS/s Sampling Rate
- 150 MHz Differential Amp
- 50 MHz Current Amplifier
- Multi-Standard Video Trigger

APPLICATIONS

- Research
- Design & Debug
- Characterization
- Automated Testing



DSA 601A/DSA 602A

DSA 601A and DSA 602A

The DSA 600A Series Digitizing Signal Analyzers provide the ultimate combination of signal acquisition, processing and display performance for repetitive and high-speed transient-capture applications. The DSA 600A Series Digitizing Signal Analyzers provide the ultimate combination of signal acquisition, processing and display performance for repetitive and high-speed transient-capture applications.

Their 1 GHz bandwidth, 2 GS/s single-shot sample rate, long waveform memory, 1 to 12 channel versatility and superb amplifier performance capture events with unsurpassed accuracy. Sophisticated signal processing features transform and combine signals to reveal key phenomena at visually live speeds. The DSA often replaces combinations of instruments through its plug-in flexibility and high-speed signal processing and display features.

In research applications, the DSA provides the bandwidth, sample rate and signal fidelity necessary to deliver accurate results. Signal processing features such as FFT and histograms present the data in the most revealing formats. For circuit design and system debugging, the sophisticated trigger system quickly isolates anomalies such as runt pulses, metastable logic states, setup/hold time violations, and slew-rate errors.

In sequential event applications such as pulsed-laser, radar and ultrasonics, partitioned, non-volatile memory captures each event for further analysis. Display-scan events from memory to find and analyze significant features or examine statistics of the entire collection to determine trends. Transport publication-ready results with the built-in floppy disk.

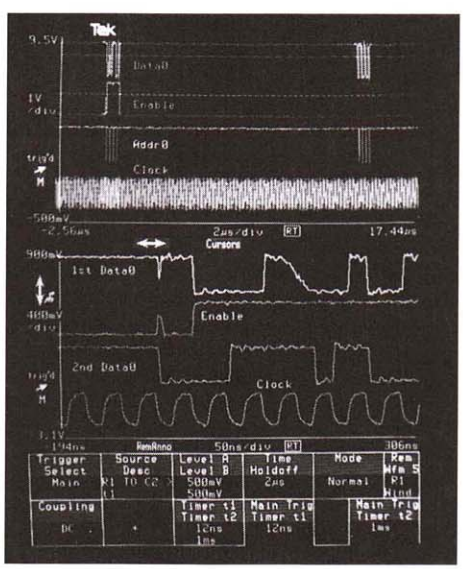


Figure 1. Isolate setup/hold time violations, metastable states and glitches quickly with time-qualified triggering. Apply the window time base to zoom in for more details. Signal paths are time-matched to probe tips for accuracy.

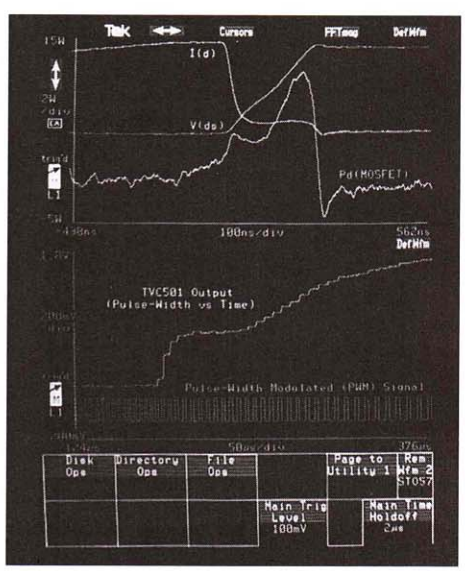


Figure 2. Capture periodic or transient current and voltage signals and accurately compute instantaneous power. Apply FFT to examine harmonics or switching noise. The TVC 501 directly demodulates pulse-by-pulse PWM.

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

GPIB IEEE-488

The DSA Series complies with IEEE Standard 488.1-1987, RS-232-C, and with Tektronix Standard Codes and Formats.

Digitizing Signal Analyzers

DSA 601A
DSA 602A

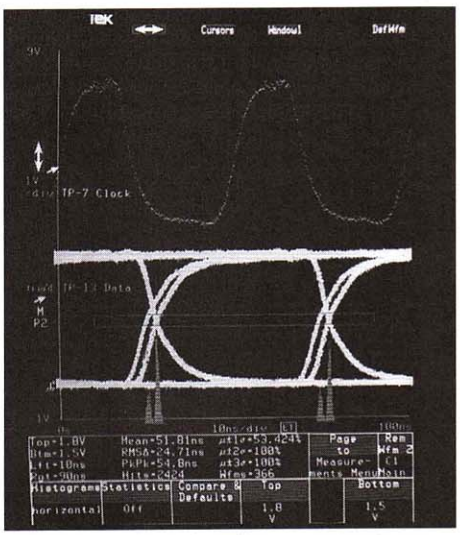


Figure 3. Analyze digital communications using variable persistence display modes. View in X-Y format for constellation display. Apply horizontal or vertical histograms to analyze jitter. Use cross-correlation for accurate propagation time measurements in extreme-noise environments.

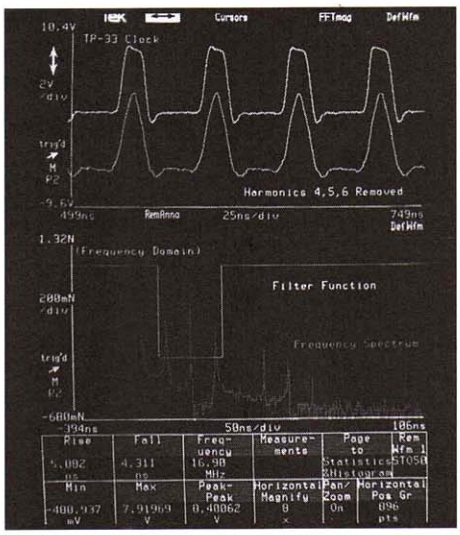


Figure 4. Apply signal processing to perform simulations. Edit the frequency spectrum of a live signal by multiplying its FFT by a filter function. Transform the result back to time-domain using IFFT and see the effects of the digital filter on the live signal. Convolution is also available for filtering.

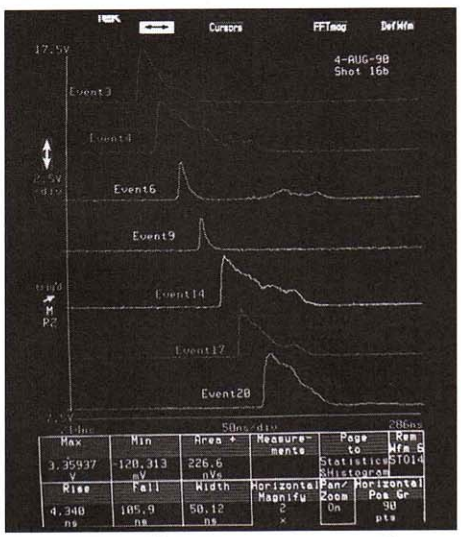


Figure 5. Rapidly capture a sequence of transient events and store them in non-volatile memory. Scan for significant events and apply measurements to individual waveforms or the entire collection. Annotate, hardcopy and transport publication-ready results on 1.44M MS-DOS compatible floppy disk.

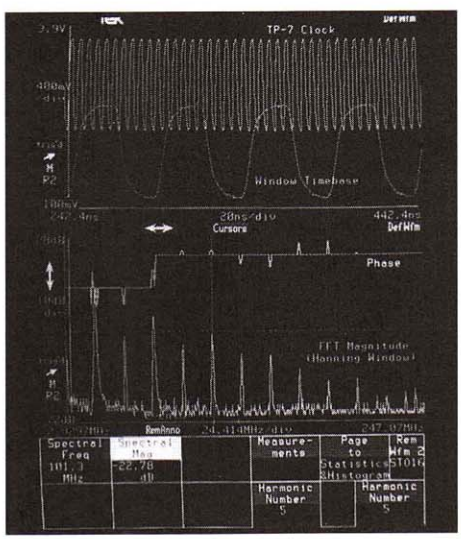


Figure 6. Simultaneously view time- and frequency-domain displays of signals at live speeds. Apply harmonic or peak-search cursors for efficient, high-accuracy readout of spectral magnitudes and frequencies. Display magnitude and phase information for repetitive or transient events.

QUICKSTART TRAINING PACKAGE
QuickStart contains application examples, and is a complete and portable training package. It can serve several users for thorough self-study or as a quick, easy reference.

The package comes complete with the QuickStart board, workbook, board reference, and power plug. This package is available to purchasers at no additional charge.

Characteristics

VERTICAL SYSTEM

Accuracy With Enhanced Accuracy – ≤1% for an 8-division signal.

Vertical Resolution – 8 bits. Resolution can be increased to 14 bits with signal averaging or smoothing.

Equivalent-Time Bandwidth – Determined by the plug-in used. See page 78.

Wide Dynamic Range – 1 mV/div to 10 V/div.

HORIZONTAL SYSTEM

Time Bases:

Sweep Speeds – 50 ps/div to 100 s/div.

Record duration – 512 ps to 1024 s in 1-2-5 sequence.

Time Base Accuracy – +0.005%, –0.015%: 0 to 45°C.

Record Length – DSA 601A: 512 to 20,480 pts (single shot); 512 to 32,768 pts (repetitive); DSA 602A: 512 to 32,768 pts (both single shot and repetitive).

Sampling Rate – DSA 601A: 1 GS/s max; DSA 602A: 2 GS/s max.

Main Record Positioning – The main record is positioned with respect to the main trigger point. At maximum pretrigger, all points except the last point in the main record precede the trigger point. At maximum post trigger, all points except the first point in the main record follow the trigger point.

Windows – The main record plus two window records may be acquired and displayed. The window records may be different lengths and can have a different time/div than the main record.

Window Record Positioning – The window records may be positioned with respect to their own trigger points on the main record. Window triggers may be delayed from the main trigger by time or events.

Multi-Trace Pan and Zoom – Multiple traces may be panned and zoomed simultaneously.

Display Interpolation – Zoomed waveforms can be displayed using either sin (x)/x or linear interpolation, or using a dots-only display without any interpolation.

Continued on next page.

DSA 601A
DSA 602A

Digitizing Signal Analyzers

Waveform Memory – More than 210K points of volatile memory shared between acquired and stored waveforms.

Settings Memory – Nonvolatile memory for approximately five settings.

TRIGGERING SYSTEM

Range – ±Full Screen.

Bandwidth – 1 GHz max: 500 MHz for extended triggering.

Coupling and Sensitivity – DC Coupled: 0.4 div from DC to 10 MHz, increasing to 1 div at maximum trigger bandwidth.

DC Noise Reject Coupled: 1.2 divs from DC to 10 MHz, increasing to 3 divs at maximum trigger bandwidth.

DC HF Reject Coupled: 0.5 divs from DC to 30 kHz.

AC Coupled: 0.4 div from 60 Hz to 10 MHz, increasing to 1 div at maximum trigger bandwidth.

AC Noise Reject Coupled: 1.2 divs from 60 Hz to 10 MHz, increasing to 3 divs at max trigger bandwidth.

AC HF Reject Coupled: 0.5 div from 60 Hz to 30 kHz.

AC LF Reject Coupled: 0.5 div from 80 kHz to 10 MHz, increasing to 1 div at max trigger bandwidth.

Holdoff Range – Main record min: 2 µs or less; max: 500 s. Window Record min: 35 ns; max: 1000 s.

WAVEFORM PROCESSING

Waveform Functions – Absolute value, average (exponential & summation), convolution, correlation, delay, dejitter, differentiate, envelope, exponential, FFT filter, IFFT integrate, interpolate, logarithm, natural log, pulse, signum, smooth, and square root. Live waveforms can be changed by using adjustable parameters.

Arithmetic Operators – Add, subtract, multiply, and divide.

FFT – Magnitude and phase; real and imaginary; inverse FFT, correlation, and convolution; six window functions; typical noise floor: –60 dB; –70 dB with averaging.

Act on Delta – Save, repeat, chime, SRQ, and hardcopy.

Histograms – Vertical or horizontal histograms generated from a user-defined portion of any waveform. Statistical information is provided for histogram data.

MEASUREMENT SYSTEM

Amplitude – Min, max, mid, mean, p-p, gain, rms, overshoot, undershoot, area +, area –, and energy.

Timing – Rise, fall, width, delay, main-to-window trigger time, period, propagation delay, cross, phase, frequency, duty cycle, and skew.

FFT – Fundamental track, harmonic amplitude, frequency, and total harmonic distortion.

Statistics – Available for any measurement listed above for both live acquisitions and groups of stored waveforms.

Cursors – Single or dual dots, split or paired mode, horizontal and vertical bars, and measurement-zone delimiters. Delta volts, delta time, 1/delta time, and slope.

INPUT/OUTPUT SYSTEM

Ports – Centronics, GPIB, and RS-232-C ports standards. Fully GPIB and RS-232-C programmable.

Data Transfer Rates – Up to 100 waveforms per second. Up to 60 measurements per second.

DISK DRIVE

One 3.5 inch microfloppy disk drive, 1.44 megabytes or 720 kilobytes formatted capacity, depending on disk used. MS-DOS compatible formatting.

CRT AND DISPLAY FEATURES

CRT – 10 in. diagonal, color, magnetic deflection. Vertical raster-scan orientation.

Resolution – 552 horizontal by 704 vertical displayed pixels.

POWER REQUIREMENTS

Line Voltage Ranges – 90 to 132 Vrms; 180 to 250 Vrms.

Line Frequency – 48 to 72 Hz.

Maximum Power Consumption – DSA 601A: 465 W max; DSA 602A: 585 W max.

ENVIRONMENTAL AND SAFETY

Temperature: (Mainframe) – Operating: 0° to +45°C. Nonoperating: –40° to +75°C.

Disk Drive – Operating: 5° to +45°C. Nonoperating: –22° to +60°C

Humidity: (Mainframe) – Operating and Nonoperating: Up to 95% relative humidity; up to +45°C.

Disk Drive – Operating: Up to 80% relative humidity; up to +30°C. Nonoperating: Up to 90% relative humidity; up to +40°C.

Altitude, Vibration, Shock, Bench Handling – Operating and Nonoperating: meets MIL-T-28800C, Type III, Class 5.

Electromagnetic Compatibility – Referenced to MIL-STD-461B. Meets FCC part 15, subpart J, class A. Meets VDE 0871/6.78 for Class "B."

Safety – Listed UL 1244; CSA Bulletin 556B, Sept. 1973; Tektronix self-certification to comply with IEC 348 recommendations.

PHYSICAL CHARACTERISTICS

	Benchtop		Rackmount	
Dimensions	**mm**	**in.**	**mm**	**in.**
Width	457	18.0	482	19.0
Height	328	12.9	311	12.3
Depth	678	26.7	678	26.7
Weight≈	**kg**	**lb**	**kg**	**lb**
Net				
DSA 601A	30.9	68.0	36.7	81.0
DSA 602A	32.7	72.0	38.6	85.0
Shipping (domestic)				
DSA 601A	48.5	107.0	55.3	122.0
DSA 602A	49.4	109.0	56.7	125.0

SINGLE-SHOT ACQUISITIONS

	DSA 601A		DSA 602A		
Sample Rate	**500 MS/s**	**1 GS/s**	**500 MS/s**	**1 GS/s**	**2 GS/s**
Number of Channels	2	1	4	2	1
Time Resolution	2 ns	1 ns	2 ns	1 ns	500 ps
Record Length	512 to 10K pts	512 to 20K pts	512 to 10K pts	512 to 20K pts	512 to 32K pts

Digitizing Signal Analyzers

DSA 601A
DSA 602A

ORDERING INFORMATION

DSA 601A
Digitizing Signal Analyzer **$24,745**
Includes: Tutorial Manual (070-7249-01), User Reference (070-7250-01), Programmer Ref. (070-7251-01), Command Ref. (070-7252-02), Service Reference (070-7254-01), Sub-miniature Probe Tip-to-BNC Adapter (013-0226-00), Power Cord, U.S., 120 V (161-0066-00).

DSA 602A
Digitizing Signal Analyzer **$32,635**
Includes: Same as DSA 601A.

Opt. 1C – Cable Feedthrough Connectors. ..... **+$200**
Opt. 1R – Rackmount ..... **+$300**
Opt. 4C – Non-Volatile RAM. Adds over 450,000 points of non-volatile storage ..... **+$1,500**
Opt. 1P – HC100 Four-Color Plotter with Opt. 01 ..... **+$1,180**
Opt. 2P – 4697 Color Quick Ink-jet Printer ..... **+$2,495**
Opt. 3P – 4693DX Color Image Printer ..... **+$8,995**

INTERNATIONAL POWER PLUG OPTIONS
Opt. A1 – Universal Euro 220 V, 50 Hz ..... **NC**
Opt. A2 – United Kingdom 240 V, 50 Hz ..... **NC**
Opt. A3 – Australian 240 V, 50 Hz ..... **NC**
Opt. A4 – North American 240 V, 60 Hz ..... **NC**
Opt. A5 – Switzerland 220 V, 50 Hz ..... **NC**
See General Customer Information Section for additional description.

WARRANTY-PLUS SERVICE OPTIONS
Opt. M7 – Calibration Service
DSA 601A ..... **+$1,085**
DSA 602A ..... **+$1,350**
Opt. M9 – Repair Protection
DSA 601A ..... **+$800**
DSA 602A ..... **+$1,000**

SOFTWARE
11000 Series/IBM PC Utility Software – Waveform/measurement data logging, graphics and statistical analysis, and GPIB and RS-232-C support. Order S47P108 ..... **$495**
SPD Signal Processing & Display Software – 196 signal processing, analysis and display routines callable from Microsoft C or BASIC, SPDMENU lets you interactively control instruments and analyze data using a convenient system of menus and graphical displays of data. Order S3FG130 ..... **$995**
Lab Windows™ – Integrated software system that supports rapid prototyping, development, and operation of test and measurement applications in either C or BASIC.*1
Order S3FG910 ..... **$695**
Lab Windows™ Advanced Analysis Library –
Signal processing support. Order S3FG912 ..... **$895**

PROBES
See page 407 for complete descriptions and full line of accessories.

Passive Probe (1 MΩ input) –
400 MHz, 11.3 pF/10 MΩ, 1.5 m
(11A32, 11A33, 11A34 only). Order P6134C **$220**
6 MHz, 105 pF/1 MΩ, 6 ft.;
200 MHz, 14 pF/10 MΩ, 6 ft.
(11A32, 11A33, 11A34 only). Order P6063B **$320**

50 Ω Divider Probe Set –
Includes both tips: 10X, 100X. 10X: 3.5 GHz, 1 pF/500 Ω, and 100X: 3 GHz, 1 pF/5000 Ω, 1.5 m. Order P6156 Opt. 25 ..... **$325**

Bias-Offset Probe – 10X, 1.5 GHz, 1.6 pF/500 Ω; 1.5 m
Order P6231 ..... **$650**

Active Probes –
10X, 750 MHz, 2 pF/1 MΩ, 1.5 m
Order P6205 ..... **$495**
10X, 1 GHz, 1.9 pF/10 MΩ, 1.5 m.
Order P6204 ..... **$1,495**
10X, 1 GHz, 2 pF/10 kΩ 1.5 m.
Order P6203 ..... **$1,200**
10X, 4 GHz, 0.4 pF/100 kΩ, 1 m. Order P6217 ..... **$3,495**

Differential Probe –
10X, 150 MHz Differential Pair, 1.5 m. (11A33 only)
Order P6135A **$695**
FET 1X/10X, DC – 100 MHz, 1000:1 CMRR. Order P6046 ..... **$2,195**

Current Probe – (11A16 only)
DC – 50 MHz, 0-20 A (DC + peak AC). Order A6302 ..... **$775**
DC – 15 MHz, 0-100 A (DC + peak AC). Order A6303 ..... **$1,420**
25 kHz-1 GHz, 0.7 A peak pulse. Order CT-1 ..... **$290**

Optical-to-Electrical Converters
DC – 1 GHz, 1100-1700 nm. Order P6703A *2
DC – 700 MHz, 450-1050 nm. Order P6701A *2
DC – 300 MHz, 1000-1700 nm, High Gain. Order P6713 ..... *2
DC – 250 MHz, 450-1050 nm, High Gain. Order P6711 ..... *2

ADDITIONAL ACCESSORIES
Cart – Instrument Cart with tilt tray, drawer, power strip.
Order K217S **$780**
Cables – GPIB, 2 m. Order 012-0630-00 ..... *2
GPIB, 2 m. Order 012-0991-00 ..... **$170**
RS-232-C, 10 ft. Order 012-0911-00 ..... **$100**
Centronics, 10 ft. Order 012-0555-00 ..... *2
Blank Panels – Plug-in. Order 016-0829-00 ..... **$160**

CAMERA/HARD COPY OUTPUT PRINTER
4-Color Pen Plotter. Order HC100 ..... **$1,075**
Camera – Order C9 with Opt. 11 ..... **$540**
Color Ink-Jet Printer. Order 4696 ..... **$1,795**

**1 For Macintosh users, virtual instrument panels and icons are available for the LabView™ instrumentation software from National Instruments.*
**2 Contact your local Tektronix representative for price information.*

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

GPIB IEEE-488 — The DSA 6011A/602A complies with IEEE Standard 488.1-1987, RS-232-C, and with Tektronix Standard Codes and Formats.

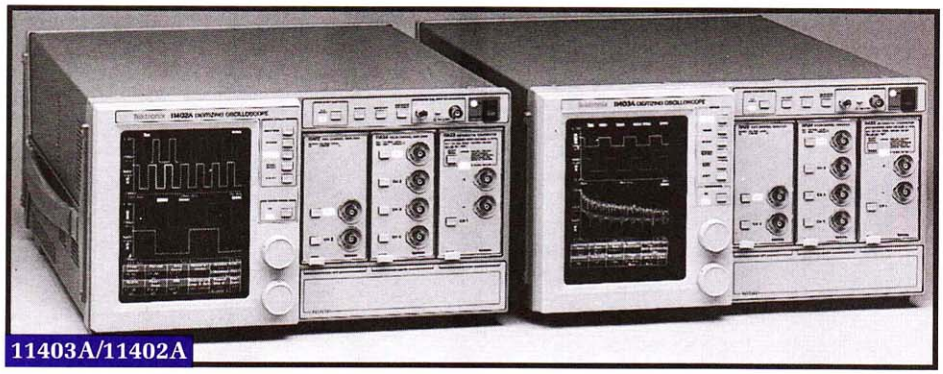
11403A
11402A

Digitizing Oscilloscopes
3 GHz/1 GHz

The 11400 Series combine high bandwidth and exceptional accuracy with excellent vertical and horizontal resolution.

11403A/11402A

- 3 GHz Bandwidth
- 2 GHz Trigger Bandwidth
- 10-bit Vertical Resolution, 14-bits with Averaging
- Acquire Up to Six Channels at 1 GHz Concurrently
- Deskew Nulls Out Channel Timing Differences – Including Probes
- Internal Calibration Capability for a Vertical Error of 1% or Less



11403A/11402A

11403A and 11402A

The Tektronix 11400 Digitizing Oscilloscope Series is as much a milestone in oscilloscope simplicity as it is in oscilloscope performance. It lets you concentrate on the measurement, without having to understand the internal operation of an oscilloscope.

The 11400 Series are fully programmable oscilloscopes whose dual time bases, 10 ps horizontal resolution and 10-bit vertical resolution – up to 14-bit with averaging – help redefine the standards of oscilloscope accuracy. Now with the introduction of the 11403A, the standard is higher than ever. It now offers even more convenience and power with built-in FFT, automatic Pass/Fail testing, and measurements on multiple waveforms.

The 11400 Series approach to user interfaces promises more thorough analysis in fewer steps. The touch screen, intuitive menu system, one-button autoset, sequencing capability and large waveform display let you think more about the measurement and less about how the oscilloscope works.

Controls are grouped around the display screen to minimize distractions. Most controls are built into a menu system on the touch screen. Touch the "Define Waveform" icon, for example, to get selections for averaging, differentiation, integration, envelope, signum, smoothing, and square root.

Select a trace, a trigger, a measurement or other function just by touching the appropriate area of the screen or by selecting from the menus. As your selection changes, the functions of the two front panel knobs change accordingly – to let you set time per division, set record lengths, or zoom and pan around a digitized record.

Even with eight traces, the update rate is faster than that of other digitizing oscilloscopes.

Press the Autoset button and the oscilloscope will autoset on a signal vertically and horizontally, and obtain a stable trigger. You can get a triggered display of either multiple cycles or a rising edge without knowing anything about the signal. Or, assign the IDENT button on the oscilloscopes probes to initiate an autoset or to sequence through a series of stored test setups – your hands and eyes never leave the job.

If accuracy is the bottom line in your application, the 11400 Series Oscilloscopes are clearly the instruments to consider first.

11403A/11402A APPLICATIONS

Device Characterization	With precision equivalent-time sampling of repetitive signals and unsurpassed accuracy and repeatability, these oscilloscopes are ideal tools for the component engineer and device designer.
Power Supply Design	With AC coupling, fast overdrive recovery, high vertical resolution, and one-touch measurements, these oscilloscopes are an excellent choice for power supply design. 11000 Series plug-in amplifiers have a wide range of calibrated offset, and can recover quickly from up to 8000 divisions of overdrive. The new 11A16 Current Amplifier plug-in gives direct reading of current and its deskew capabilities allow high accuracy instantaneous power calculations using the waveform processing capabilities of the 11403A and 11402A.
Production Testing	High accuracy, full programmability, the flexibility and performance of 11000 Series plug-ins, and fast ATE throughput give the production test user significant cost savings. Speed manual adjustment of circuit performance with the Pass/Fail testing feature. Coupled with the multiple waveform measurement capabilities, the Pass/Fail testing feature makes the 11400 a stand-alone testing system.

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

GPIB IEEE-488

The 11403A, 11402A complies with IEEE Standard 488.1-1987, RS-232-C, and with Tektronix Standard Codes and Formats.

Digitizing Oscilloscopes

3 GHz/1 GHz

11403A
11402A

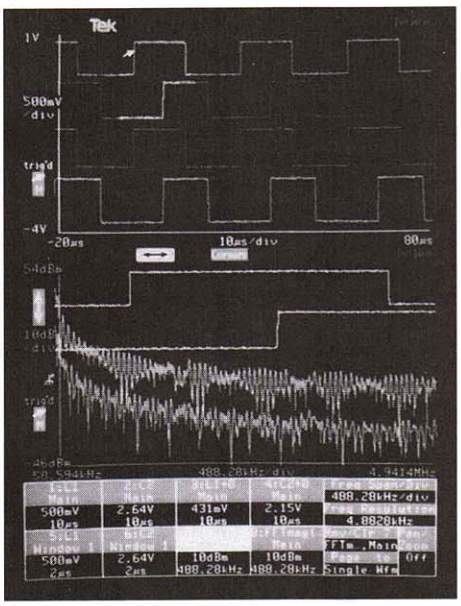


Figure 1. FFT display and measurements in the 11403A offer additional analysis power to the engineer or scientist.

Acquisition & Analysis Power

From the engineering bench to the production line, the 11403A and 11402A give you the power to acquire, measure, process and output waveforms with a standard of accuracy exclusive to the 11400 Series.

The 11403A has a full-color display that let you easily distinguish between multiple waveforms. Main waveforms are displayed in up to four different colors, with one additional color designated for window waveforms. The 11402A has a high-resolution monochrome display for large, sharp view of your signals.

Equipped with three plug-in compartments and dual time bases, the 11403A and 11402A can continuously acquire and display 8 signals from up to 12 input channels. Dual time bases permit simultaneous capture and display of up to two window records for each main record acquired. Main and window records in the 11400 oscilloscopes are analogous to main sweep and delayed sweep acquisitions in analog oscilloscopes. Window acquisitions can be positioned anywhere within the main record and allow detailed analysis of critical areas of the main waveform.

The 11403A and 11402A incorporate extensive triggering capabilities including selectable AC or DC coupling, AC or DC noise reject, as well as high and low frequency reject. Pretrigger or posttrigger details can be viewed on the main trace. 2 GHz trigger bandwidth (11A81) lets you trigger on extremely fast transitions.

THE USER INTERFACE

The 11403A and 11402A's comprehensive analysis functions, and instrument controls – including plug-ins and probes – are accessible to the user through a minimum of front panel buttons, two user-assignable control knobs, and an easy-to-operate, touch-screen interface.

ADVANCED ANALYSIS WITHOUT DELAY

"Live" update of the display and waveform measurement parameters lets you observe phenomena as they occur, and allows complex mathematical transformations and functions to be applied to the acquired data in near real time.

Advanced waveform calculations such as differentiation, integration, square root, logarithm, and absolute value are available at the touch of an on-screen selector. No more waiting for results while an external processor works on the acquired data. All measurements and calculations are continuously updated as the instrument acquires the signal.

Built-in statistical analysis capability lets you get a better picture of how a signal varies over time – providing min, max, mean, and standard deviation for all selected measurements. Dedicated digital signal processing hardware provides acquisition enhancement functions such as averaging and smoothing to selectively remove noise from the display, giving you visibility into the true behavior of circuits and devices never before seen without extensive delayed signal processing.

The 11403A offers additional analysis power beyond the 11402A. It adds FFT display and measurements – a useful tool for the design engineer and scientist. You can create FFT magnitude or phase displays of the acquired waveform and use the automatic Spectral Frequency, Spectral Magnitude, and THD (Total Harmonic Distortion) measurements for a complete analysis of your signals.

MEASUREMENT SYSTEM

The 11403A and 11402A offer one of the most comprehensive sets of automatic measurements available today. All measurements can be programmed over the GPIB or RS-232-C interfaces, eliminating operator error and enhancing test repeatability.

The 11403A and 11402A measurement system is especially useful in automated test applications where the oscilloscope can acquire waveforms, make the measurements, and report the results to the host controller. Measurement results can be processed more rapidly and use much less memory space than the raw waveform data.

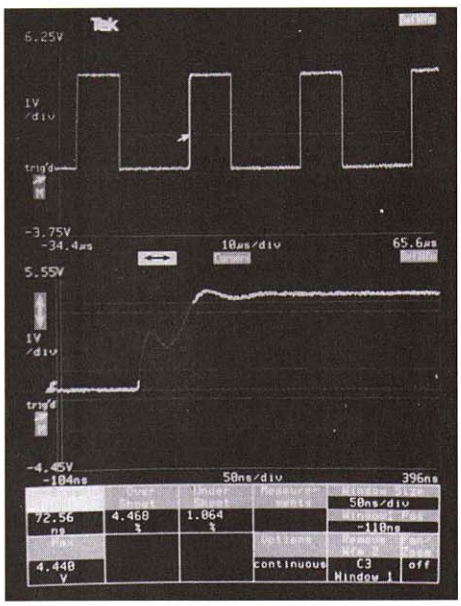


Figure 2. In the Annotation Mode, horizontal cursor bars and highlighting serve to focus your attention on the portion of the waveform being measured.

ANNOTATIONS

All of the 11403A and 11402A measurements are fully annotated to clearly identify the portion of the waveform being measured, and to show the locations of the measurement thresholds (see Figure 2). The measured portion of the waveform is highlighted and horizontal and vertical lines are used to track the upper and lower limits of the measured portion, and the 10% as well as 90% values.

All critical measurement limits are easily adjusted and displayed in the measurement pop-up menus. For example, if you want rise time measurements from 20% to 80% instead of from 10% to 90%, you simply set these levels with the control knobs, or with an on-screen numeric key pad. Values can be set in relative (percent) or absolute terms.

Continued on next page.

11403A
11402A

Digitizing Oscilloscopes
3 GHz/1 GHz

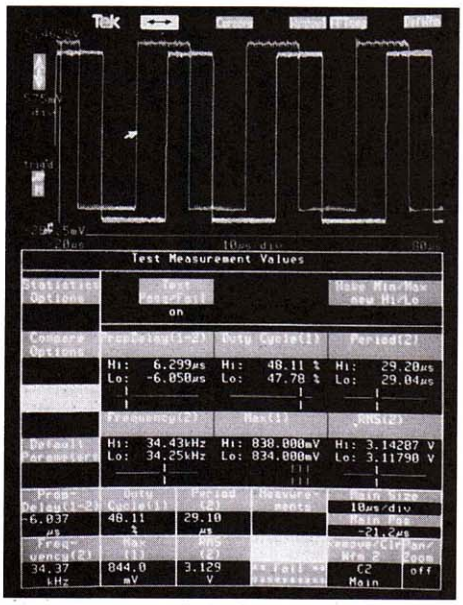


Figure 3. Pass/Fail testing offers a fast, easy method of adjusting circuit operation or sorting parts in production applications.

PASS/FAIL TESTING

Both the 11403A and 11402A offer Pass/Fail testing on measurements. ATE and production test applications can use Pass/Fail testing to speed throughput and simplify circuit adjustment. Maximum and minimum limits are set for each active measurement, then the instrument gives indication of whether the signals Pass or Fail. A horizontal scale with a vertical bar serves as visual indication of where the measurement fell between the set limits. If the test failed, the scale indicates whether the signal was high or low.

MULTIPLE WAVEFORM MEASUREMENTS

Adding to the capabilities of the 11403A and 11402A measurement system is the ability to make any measurement on any waveform. You can assign measurements to specific waveforms, use the same measurement for several waveforms, and have the results all on one display. For example, you could measure the skew on all four outputs of a buffer simultaneously. When you combine multiple waveform measurements with Pass/Fail testing, you can greatly simplify production testing and circuit adjustment.

PLUG-IN MODULARITY

The 11403A and 11402A are equipped to handle up to three 11000 Series plug-ins. (For a list of plug-ins and characteristics, see page 78.) Several plug-ins are available, offering a range of bandwidths, channels, and input impedances to choose from. Plug-in installation is a simple matter of sliding each unit into place. Plug-ins are controlled through the mainframe, either from the touch screen interface, or via the IEEE 488 or RS-232-C.

RECORD LENGTH

Record length is selectable from 512 to 10,240 points, providing the ability to capture and analyze repetitive events in high detail.

WAVEFORM MEMORY AND NONVOLATILE STORAGE

The standard 11403A and 11402A are equipped with 512 kilobytes of volatile waveform acquisition and display memory, and 128 kilobytes of non-volatile memory for storage of waveforms and settings. These memories are independent; that is, the number of waveforms being acquired has no impact on the memory available for stored waveforms and settings.

For users who require additional memory, Option 2D adds an additional 768 kilobytes of non-volatile memory for storage of waveforms and settings. This provides a total of 896 kilobytes of non-volatile memory – enough for approximately 450 waveforms of 1K point record length.

DOCUMENTATION

Documenting your results with the 11403A and 11402A is as easy as pressing one button. HARDCOPY sends a high-resolution copy of the current screen, complete with label and time and date stamp, through your choice of a standard Centronics parallel printer, RS-232-C, or GPIB port to any compatible printer or plotter – including the Tektronix 4696 and 4693D color printers, and HC100 color plotter (see Figure 4).

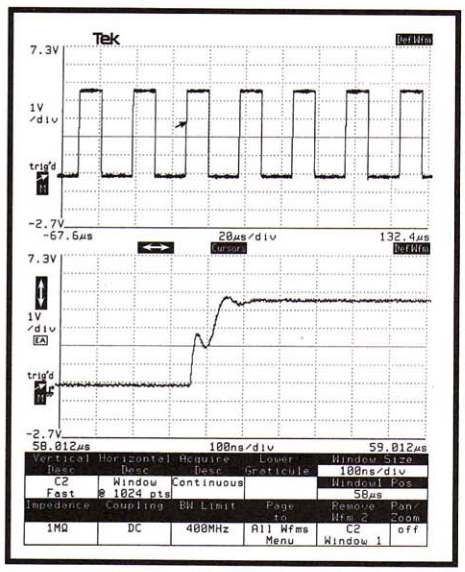


Figure 4. 11400 hardcopy output.

Applications

DEVICE CHARACTERIZATION

The 11403A and 11402A are designed for precision, equivalent-time sampling of repetitive signals. Their unsurpassed accuracy and repeatability make them the ideal tools for the component engineer and device designer.

Dual built-in time bases allow windowing for detailed timing analysis of devices. Time A to B measurements can be made with 200 ps resolution single shot, or 10 ps resolution with repetitive acquisitions. Multiple signal acquisition and display eliminates the need to multiplex channels, and allows you to see cause and effect relationships on the same screen. For critical applications, the 10-bit vertical resolution can be increased to 14-bits with averaging.

The 11403A offers a unique level of analysis power when Option 1S, Statistical Database Analysis Package, is added. With this option, the 11403A can make direct jitter and noise measurements on your incoming signals. It builds up a history – a statistical database – of acquisitions and provides histograms, measurements, special color graded displays, and mask testing options which allow you to more fully characterize and analyze your circuitry than ever before. These techniques are excellent for analyzing random data such as computer bus data streams, making timing analysis on digital signals, and characterizing metastability. And the color display of the 11403A lets you easily distinguish among multiple waveforms.

Digitizing Oscilloscopes

3 GHz/1 GHz

11403A
11402A

POWER SUPPLY DESIGN

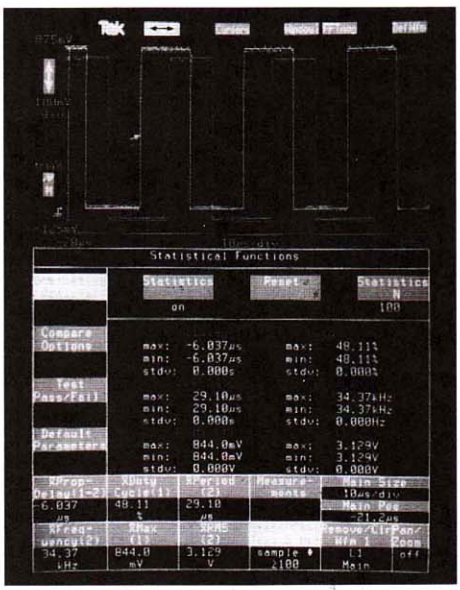
The 11403A and 11402A with 11000 Series plug-ins provide AC coupling, fast overdrive recovery, high vertical resolution, and one-touch measurements; making this combination an ideal tool for power supply design. 11000 Series plug-in amplifiers have a wide range of calibrated offset, and are unsurpassed in their ability to recover quickly from up to 8000 divisions* of overdrive.

The 11403A and 11402A can extend the sensitivity and offset of the plug-ins by increasing their normal 10-bit vertical resolution to 14 bits with high-precision averaging. With this kind of resolution, and the 11A33 Differential Comparator plug-in, small signals riding on larger signal swings or high DC voltages (such as ripple and noise) can be easily spotted and isolated. The 11A16 current amplifier provides AC + DC current measurement with scaled and calibrated results. Directly measure current waveforms or multiply voltage and current to create an instantaneous power trace. Time deskew at the probe tips eliminates phase errors between voltage and current traces, maintaining accuracy even on fast switching transitions.

PRODUCTION TESTING

ATE and production test users reap many benefits from the 11403A and 11402A. Full programmability and commands optimized for fast operation ensure the highest throughput in ATE applications. Flexibility of configuration and high performance of 11000 Series plug-ins mean a production testing system can be tailored to fit your needs today – and expanded tomorrow as your needs change and grow. Special features like Pass/Fail testing, multiple waveform measurements, and a full range of automatic measurements give the 11403A and 11402A the ability to perform many more functions than ordinary oscilloscopes and can even replace other test equipment. The high accuracy of the 11403A and 11402A provides an extra margin of safety for your tests, and their fast measurements reduce test times which saves you money.

**With an 11A33.*



STATISTICAL ANALYSIS

Statistical analysis of measurements provides maximum, minimum, mean, and standard deviation for up to six measurements at once. This feature is useful for statistical quality control, ATE test development, and device characterization.

Characteristics

VERTICAL SYSTEM WITH ENHANCED ACCURACY:

ΔVDC Accuracy – ≤1% for an 8-division signal.

Absolute DC Accuracy – ≤0.6% when using full scale of the plug-in offset range.

ENHANCED ACCURACY automatically expires when the instrument temperature changes by approximately ±5°C from the temperature of the last calibration. Even if the ENHANCED ACCURACY is not renewed, the accuracy typically remains ≤2%.

11000 Series Probes can be included in calibration. The instrument will prompt you to connect the probes to the CALIBRATOR.

Vertical Resolution – 10 bits (1024 levels). Resolution can be increased to 14 bits (16384 levels) with signal averaging.

Equivalent-Time Bandwidth – 3 GHz max determined by plug-in. See page 78.

HORIZONTAL SYSTEM

Time Bases – Two identical, independent, built-in time bases.

Record Duration – 5.11 ns to 1024 s in 1-2-5 sequence.

Time Base Accuracy – 100 ps +0.002% of measurement interval.

Record Length – 512, 1024, 2048, 4096, 5120, 8192, and 10240 points.

Sampling Rate – 20 MS/s max.

Main Record Positioning – The main record is positioned with respect to the main trigger point. Pretrigger: One record duration
Posttrigger: One record duration
Resolution: One main record point

Continued on next page.

11403A
11402A

Digitizing Oscilloscopes
3 GHz/1 GHz

Windows – The main record plus two window records can be acquired and displayed. The window records can be of a different length (duration) and can have a shorter time/div than the main record. If two window records are used, they have the same duration and time/div settings, but can be positioned independently.

Window Record Positioning – The window records are positioned relative to a window trigger point which can be delayed by either time or events relative to the main record's trigger point.

Main-to-Window Trigger Time Measurements – The time between the Main record trigger and the Window trigger can be measured precisely, even if each trigger only occurs once. Repetitive events allow this measurement to be averaged for better resolution and accuracy.
Single Trigger Resolution: 200 ps
Repetitive Resolution: 10 ps with averaging
Accuracy: 250 ps +0.002% of measured interval.

TRIGGERING SYSTEM

Range – ± Full Scale.

Main Trigger, Coupling and Sensitivity:
Jitter (Typical, CSA 404 only) – 10 ps rms; 70 ps peak-to-peak.

DC Coupled – 0.5 div from DC to 50 MHz; 1.5 div from 50 MHz to 1 GHz.*1

Noise Reject Coupled – 1.2 div or less from DC to 50 MHz; 3 div from 50 MHz to 1 GHz.*1

AC Coupled – 0.5 div from 60 Hz to 50 MHz; 1.5 div from 50 MHz to 1 GHz.*1 Attenuates signals below 60 Hz.

HF Reject Coupled – 0.65 div from DC to 30 kHz.

LF Reject Coupled – 0.65 div from 80 kHz to 50 MHz; 1.5 div from 50 MHz to 1 GHz.*1

Window Trigger, Coupling and Sensitivity:
DC Coupled – 0.5 div from DC to 50 MHz; 1.5 div from 50 MHz to 500 MHz.*1

Note: Using the 11A81 External Trigger Input provides ≥ 2GHz trigger Bandwidth

Noise Reject Coupled – 1.2 div or less from DC to 50 MHz; 3 div from 50 MHz to 500 MHz.*1

AC Coupled – 0.5 div from 60 Hz to 50 MHz; 1.5 div from 50 MHz to 500 MHz.*1 Attenuates signals below 60 Hz.

HF Reject Coupled – 0.65 div from DC to 30 kHz.

LF Reject Coupled – 0.65 div from 80 kHz to 50 MHz; 1.5 div from 50 MHz to 500 MHz.*1

Holdoff Range:
Main Record – Min: 490 ns; max: 10 s.

Window Record – Min: 20 ns; max: 811 s.

MEASUREMENT SYSTEM

Waveform Processing Functions:
Waveform Functions – Differentiate, integrate, interpolate, smooth, average, envelope, square root, signum, logarithm, natural log, absolute value, and exponential.

Arithmetic Operators – Add, subtract, multiply, divide.

MEASUREMENT SET

Amplitude – Min, max, mid, mean, gain, p-p, undershoot, overshoot, amplitude, noise*2, extinction ratio, and RMS.

Timing – Rise, fall, width, delay, main-to-window trigger time, phase, period, duty cycle, skew, jitter*2, propagation delay, cross, and frequency.

Area and Energy – Area +, area –, and energy.

FFT (11403A only) – Spectral frequency, spectral magnitude, THD (Total Harmonic Distortion).

Measurement Statistics – Min, max, mean, and standard deviation of all active measurements.

Cursors – Dual dots in split or paired mode, horizontal and vertical bars, measurement zone delimiters.

INPUTS/OUTPUTS

Centronics, GPIB, and RS-232-C ports standard. Fully GPIB and RS-232-C programmable.

Hardcopy Drivers – Support for Tek HC200 and 9 pin and 24-pin Epson-graphics compatible printers; Tek HC100 and HPGL-compatible plotters; Tek 4693, 4696, 4697 color printers; alternate inkjet printers; bit map transfer to computers. Draft, high resolution, and reduced modes.

CRT AND DISPLAY FEATURES

CRT – Magnetic deflection, vertical raster-scan orientation. 7.5-inch diagonal color CRT in 11403A and CSA 404. 9-inch diagonal monochrome CRT in 11402A.

Colors (11403A and CSA 404) – Eight-color set; selectable from a palette of 262,144 colors.

Video Resolution – 552 horizontal by 704 vertical displayed pixels.

ENVIRONMENTAL AND SAFETY

Temperature – Operating: 0° to +50°C. Nonoperating: –40° to +75°C.

Humidity – Operating and Nonoperating: Up to 95% relative humidity, up to +50°C.

Altitude – Operating and Nonoperating: meets MIL-T-28800C, Type Class 5.

Vibration – Operating: meets MIL-T-28800C, Section 4.5.5.3.1, Type Class 5.

Shock – Nonoperating: meets MIL-T-28800C, Section 4.5.5.4.1, Type Class 5.

Bench Handling – Operating: meets MIL-T-28800C, Section 4.5.5.4.3, Type Class 5.
Electromagnetic Compatibility – Meets the following requirements of MIL-STD-461B - CE-03, Part 4, Curve 1; CS-01, Part 7; CS-02, Part 4; CS-06, Part 5; RE-02, Part 7; RS-01, Part 4; RS-02, Part 5; RS-03, Part 7 (limited to 1 GHz). Meets FCC part 15, subpart J, class A. Meets VDE 0871/6.78 for Class B.

Safety – Listed UL 1244; CSA Bulletin 556B, September 1973; Tektronix self-certification to comply with IEC 348 recommendations.

PHYSICAL CHARACTERISTICS

	Benchtop		Rackmount	
Dimensions	**mm**	**in.**	**mm**	**in.**
Width	448	17.6	482	19.0
Height	238	9.4	222	8.8
Depth	599	23.6	550	21.6
Weight ≈	**kg**	**lb**	**kg**	**lb**
Net	19.0	41.6	22.0	48.0
Shipping (domestic)	28.0	62.0	31.4	68.0

**1 At minimum holdoff setting.*
**2 CSA 404 and 11403A option 1S only.*

Digitizing Oscilloscopes
3 GHz/1 GHz

11403A
11402A

ORDERING INFORMATION

11403A
1-GHz Color Digitizing Oscilloscope. **$18,950**
Includes: Tutorial (070-8190-00); User Reference (070-8191-00); Programmer Reference (070-8192-00); Quick Reference (070-8193-00); Service Reference (070-8194-00); Power Cord, U.S. 120 V (161-0066-00).

11402A
1-GHz Monochrome Digitizing Oscilloscope **$15,700**
Includes: Same as 11403A except Service Reference (070-7848-00).

Opt. 1C – Cable Feedthrough Connectors ..... **+$200**

Opt. 1R – Rackmount ..... **+$250**

Opt. 1S – (11403A only) Statistical Data Base Analysis Package. Adds statistical data base measurement functions, color graded display, mask testing, direct Jitter and Noise measurements, and histogram analysis ..... **+$4,000**

Opt. 2D – Memory Expansion. Adds 768 kbytes of nonvolatile memory for storage of waveforms and settings. ..... **+$1,500**

Opt. 4D – DMA Controller
Increases transfer speed over GPIB ..... **+$400**

INTERNATIONAL POWER PLUG OPTIONS
Opt. A1 – Universal Euro 220 V, 50 Hz ..... **NC**
Opt. A2 – United Kingdom 240 V, 50 Hz ..... **NC**
Opt. A3 – Australian 240 V, 50 Hz ..... **NC**
Opt. A4 – North American 240 V, 60 Hz ..... **NC**
Opt. A5 – Switzerland 220 V, 50 Hz ..... **NC**
See General Customer Information Section for additional description.

WARRANTY-PLUS SERVICE OPTIONS
Opt. M7 – Calibration Service
11403A ..... **+$415**
11402A ..... **+$395**

Opt. M9 – Repair Protection
11403A ..... **+$1,179**
11402A ..... **+$1,150**

Opt. Q2 – Customer Site HW Service
11403A ..... **+$1,330**
11402A ..... **+$1,295**

SOFTWARE
See Software Section for additional information.

11000 Series/IBM PC Utility Software – Waveform/measurement data logging, graphics and statistical analysis.
Order S47P108 ..... **$4,995**

EZ-TEST – Simple means to specify high-level test functions using instruments in an online learning mode.
Order S45F030 ..... **$995**

Signal Processing & Display Software (SPD) **–** 196 signal processing, analysis and display routines callable from Microsoft C or BASIC, SPDMENU to interactively control instruments and analyze data using a convenient system of menus and graphical displays of data. Order S3FG130 ..... **$995**

Lab Windows™ – Integrated software system that supports rapid prototyping, development, and operation of test and measurement applications in either C or BASIC.*1
Order S3FG910 ..... **$695**

PROBES
See page 407 for descriptions and full line of accessories.

Passive Probe (1 MΩ input)
10X, DC – 400 MHz, with readout and identify (11A32, 11A33, 11A34 only). Order P6134C **$220**
1X/10X, DC – 200 MHz with readout (11A32, 11A33, 11A34 only). Order P6063B **$320**

Low-Z Probes (50 Ω input)
10X, DC – 3.5 GHz, ≤1 pF, 500 Ω. Order P6156 ..... **$265**
100X, DC – 3.0 GHz, ≤1.1 pF, 5000 Ω (includes 10X tip). Order P6156 Opt. 25 ..... **$325**

Bias-Offset Probe
10X, DC – 1.5 GHz, 1.6 pF, 450 Ω. Order P6231 ..... **$650**

Active Probes
10X, DC – 1 GHz, ≥10 MΩ input impedance, 1.9 pF. Order P6204 ..... **$1,495**
10X, DC – 750 MHz, ≥1 MΩ input impedance, 2.0 pF. Order P6205 ..... **$495**
10X, DC – 4 GHz, 100K 2/0.4 pF. Order P6217 ..... **$3,495**

Differential Probe – 10X, DC – 150 MHz (11A33 only), 1 MΩ, 10.5 pF. Order P6135A **$695**
1X/10X, DC – 100 MHz, 10,000:1 CMRR. Order P6046 ..... **$2,195**

Current Probe (11A16 only)
DC – 50 MHz, 0-20 A (DC + peak AC). Order A6302 ..... **$775**
DC – 15 MHz, 0-100 A (DC + peak AC). Order A6303 ..... **$1,420**

Current Transformer
25 kHz-1 GHz, max current of 0.5 A rms. Order CT-1 ..... **$290**

Optical-to-Electrical Converters (See page 226)
DC – 1 GHz, 1100-1700 nm. Order P6703A *2
DC – 700 MHz, 450-1050 nm. Order P6701A *2
DC – 300 MHz, 1000-1700 nm, High Gain. Order P6713 ..... *2
DC – 250 MHz, 450-1050 nm, High Gain. Order P6711 ..... *2

ADDITIONAL ACCESSORIES
Cart – Instrument cart with tilt tray, drawer, power strip.
Order K217S **$780**

Cables – GPIB, 2 m. Order 012-0991-00 ..... **$170**
RS-232-C, 10 ft. Order 012-0911-00 ..... **$100**
Centronics, 10 ft. Order 012-0555-00 ..... *2

Blank Panels – Plug-in. Order 016-0829-00 ..... **$160**

CAMERA/HARD COPY OUTPUT PRINTER
Camera – Order C9 with Opt.11 ..... **$540**
4-color pen plotter. Order HC100 ..... **$1,075**
Color ink-jet printer. Order 4696 ..... **$1,795**

**1For Macintosh users, virtual instrument panels and icons are available for the LabView™ instrumentation software from National Instruments.*

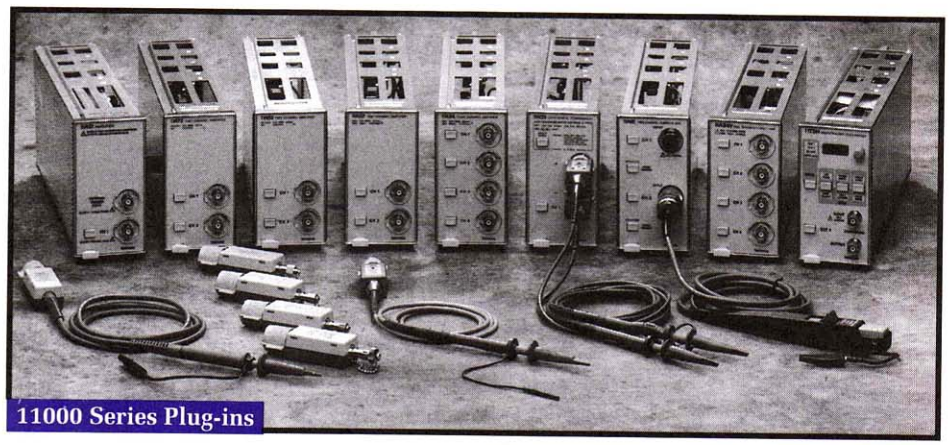
**2Contact your nearest Tektronix representative for price and availability.*

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

GPIB IEEE-488 — The 11403A/11402A complies with IEEE Standard 488.1-1987, RS-232-C, and with Tektronix Standard Codes and Formats.

Plug-in Information

Wide bandwidth, unsurpassed accuracy, clean response, low noise, and calibrated DC offset with fast overdrive recovery.



11000 Series Plug-ins

11000, DSA Series Plug-ins

A variety of bandwidths, number of channels, coupling and input choices are available. From the 11A72 with 2 channels at 1 GHz bandwidth to the 11A33 differential comparator with 150 MHz bandwidth and 10,000:1 CMRR, the 11000 Series plug-ins offer capabilities for virtually any need. The chart below shows the bandwidth of each of the plug-in units in each of the 11000 Series and DSA 600A Series mainframes.

Control of the 11000 Series plug-ins is accomplished through the mainframe controls, either manually or over the IEEE Standard 488 or RS-232-C bus. A single pushbutton for each channel is the only control on the amplifier plug-in. This button turns the display of the associated channel on and off.

Each of the input channels on all amplifier plug-ins use the TekProbe™ interface. This interface allows the mainframe to supply power to active probes (such as the P6204 or P6703A), to sense the type (and, with some probes, the serial number) of the probe, to supply offset voltage to probes so equipped, to detect activation of the probe's ID pushbutton, and to provide other communication between the probe and the oscilloscope as appropriate to the type of probe.

Three new plug-ins extend the capabilities of the 11000 Series and DSA 600 Series even further. The 11A16 Current Amplifier provides direct measurement of current waveforms. Analysis of power circuits can be more complete than ever before. The 11T5H Multi-Standard Video Trigger and 11A34V High Bandwidth Video Amplifier are companion plug-ins for the high performance video designer. They allow triggering and measurements on video signals for HDTV, medical imaging systems, graphics monitors, and other video systems.

The 11A33 Differential-Comparator Amplifier bandwidth is 150 MHz with any combination of probe and mainframe. The recommended probe for this amplifier is the P6135A matched probe pair.

11000 SERIES PROBE PLUG-IN MAINFRAME BANDWIDTH MATRIX

All values are in MHz and are rounded to nearest 25 MHz increment

	No probe	P6134C	P6231	P6203	P6204	P6156	P6701A*1	P6703A*1	P6711*1	P6713*1	P6205/ P6501 Opt. 02*2	P6217
		passive 10 MΩ 11.3 pF 10X	bias/offset 450 Ω 1.6 pF 10X	active 10 kΩ 2.0 pF 10X	active 10 MΩ 1.9 pF 10X	passive 500, 5 kΩ <1 pF, 10X, <1.1 pF 100X	optical — — —	optical — — —	optical — — —	optical — — —	active 1 MΩ 1.8 pF 10X	active 100 kΩ 0.4 pF 10X
11A32	400	400	375	375	375	400	300	350	175	175	350	375
11A34	300	300	300	275	275	300	250	275	150	175	275	275
11A34V	300	300	—	—	—	—	—	—	—	—	—	—
11A52	600	—	550	500	500	600	375	475	175	200	475	575
11A72	1000	—	825	700	700	1000	450	575	175	200	600	950
11A81	3000	—	850	700	700	—	—	—	—	—	—	2400

**1 The bandwidths in this chart correspond to –3 dB electrical net system bandwidth. Optical/Electrical converters are often specified at a –3 dB optical point (= –6 dB electrical). To convert to –3 dB optical bandwidth, multiply the bandwidths in this chart by 1.4. For more details on Optical-to-Electrical Converters, see page 226*

**2 P6501 Option 02 microprobe is a probe-card mounted, active probe that draws power from the TekProbe interface found on 11000 Series plug-ins.*

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

GPIB IEEE-488 — The 11000 Series complies with IEEE Standard 488.1-1987, and with Tektronix Standard Codes and Formats.

Plug-In Amplifiers
3 GHz

11A81 3 GHz Amplifier

The 11A81 is a single channel, high-bandwidth, presampler plug-in designed specifically for the 11403A Digitizing Oscilloscope and the CSA 404 Communications Signal Analyzer. The unique presampler architecture of the plug-in triples the system bandwidth of these mainframes to 3 GHz. A separate trigger input with 2 GHz bandwidth effectively doubles their trigger bandwidth.

Up to three 11A81s can be used together in the 11403A/CSA404 to form a powerful, high bandwidth measurement system for high-speed GaAs or ECL logic device development. Perform voltage measurements to 1% accuracy, sophisticated jitter and noise analysis with histograms, or precise pass/fail evaluations.

Coupled with the CSA 404, the 11A81 allows accurate testing of communications devices, modules and systems with data rates to 625 Mb/sec. This makes the 11A81/CSA 404 combination ideally suited to FDDI and SONET applications. With this comprehensive communications measurement system you can perform eye pattern analysis, create masks for pass/fail testing, or generate constellation diagrams for analysis of digital RF circuits.

The input channel and external trigger input connectors of the 11A81 are standard BNC with TEKPROBE™ interfaces to insure compatibility with a wide selection of high performance probes.

Characteristics

Bandwidth – 3 GHz typical (calculated from rise time using the formula BW = $0.38/t_r$).

Risetime – ≤130 ps.

Deflection Factor – 10 mV to 1 V/div in 1-2-5 sequence.

Accuracy – ΔV: ±(1.0 + 0.01 div.); Offset: ±(0.6% + 0.01 div.); DC Balance: ±0.1 div.

Offset Range – ±50 divisions. Resolution: Coarse – 0.25 div; Fine – 0.025 div.

Overdrive Recovery – At 10 and 20 mV/div: to within ±(2.0% +0.1 div) within 10 ns from ±1 V step.

Typical Displayed Noise (RMS) – 0.025 div from 10 mV/div to 1 V/div.

Input Impedance – 50 Ω ±1.0%; VSWR ≤1.45:1 at 10 mV/div, DC to 2 GHz; VSWR ≤1.25:1 at 20 mV/div to 1 V/div, DC to 2 GHz.

Disconnect Threshold – DC signal: ±(6 V ±1 V); AC signal: 5 Vrms typical (DC to 100 MHz).

Input Coupling Modes – DC and OFF.

Maximum Input Voltage – 5 Vrms (0.5 W) or 0.25 watt-second pulses not exceeding 25 V peak.

External Trigger – Range: ±1 V. Resolution: Fine: ±2 mV/step; Coarse: ±20 mV/step. Accuracy: ±5% of trigger level range. Sensitivity: 40 mVp-p from DC to 200 MHz; increasing to 150 mVp-p at 800 MHz; increasing to 200 mVp-p at 2 GHz. Maximum Safe Input Level: ±1 V.

Internal Trigger – Sensitivity: 2.0 div p-p from DC to 625 MHz, typically increasing to 4.5 div p-p at 1 GHz.

ENVIRONMENTAL CHARACTERISTICS

Temperature – Operating: 0°C to 50°C; Nonoperating: –40°C to +75°C.

Altitude – Operating: to 4.57 km (15,000 ft.); Nonoperating: to 15.2 km (50,000 ft.).

MIL Specs – Meets requirements of MIL-T-28800D, Type III, Class 5 for humidity, shock and vibration. Meets requirements of MIL-STD-461B; FCC Part 15, subpart J, Class A; and VDE 0871/6.78 Class B for electromagnetic compatibility.

11A81

- Single Channel
- High-Bandwidth, 3 GHz

Extreme bandwidth for device characterization or analysis of communications systems to 625 M bit/sec.

ORDERING INFORMATION

11A81
Single-Channel Amplifier **$5,495**
Includes: User Ref. (070-8147-00) and Service Ref. (070-8148-00)

Opt. 20 – Includes P6217 active probe ..... **+$3,495**

WARRANTY-PLUS SERVICE OPTIONS

Opt. M7 – Calibration Service ..... **+$175**

Opt. M9 – Repair Protection ..... **+$325**

Opt. Q2 – Customer Site HW Service ..... **+$375**

PROBES
See page 423 for complete descriptions and full line of probes.

Active –
1 GHz, 1.9 pF/10 kΩ, 1.5 m. Order P6204 ..... **$1,495**
4 GHz, 0.4 pF/100 kΩ, 1 m. Order P6217 ..... **$3,495**

50 Ω Divider – 50 Ω inputs. Divider probe set includes both of the following: 3.5 GHz, 1 pF/500 Ω; 3 GHz, 1 pF/5000 Ω, 1.5 m. Order P6156 with Opt. 25 ..... **$325**

Current –
25 kHz – 1 GHz. Order CT-1 ..... **$290**
1.2 kHz – 200 MHz. Order CT-2 ..... **$250**

Differential – 100 MHz Active Fet, 6 ft. Order P6046 ..... **$2,195**

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

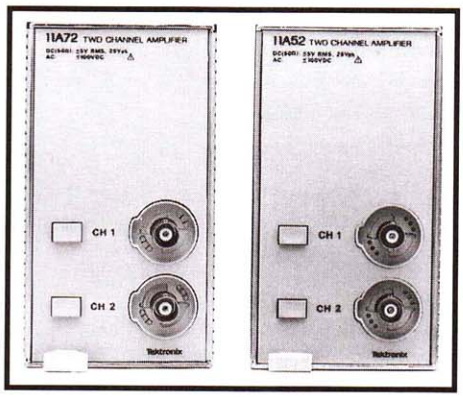
11A72
11A52

Plug-In Amplifiers
High Bandwith

High bandwidth amplifiers combined with active probes preserve critical signal phenomena in research and design.

11A72
- 1 GHz
- Two Channels
- 50 Ω Input Impedance
- DC to 1 GHz Bandwidth
- 10 mV to 1 V/Div Calibrated Deflection Factors
- ±25 Division Offset

11A52
- 600 MHz
- Two Channels
- 50 Ω Input Impedance
- DC to 600 MHz Bandwidth
- 1 mV to 10 V/Div Calibrated Deflection Factors in 1% Increments
- High-Resolution Calibrated DC Offset
- Fast Overdrive Recovery



11A72 Two-Channel Amplifier Characteristics

Bandwidth – 1 GHz.

Deflection Factor – 10 mV to 1 V/div in 1-2-5 sequence.

Accuracy – ΔVolts DC accuracy: With 11400: ±(0.9% +0.01 div) . With DSA 600: ±(1.0% +0.02 div). DC Balance, ±0.1 div. Offset Accuracy, ±(0.4% +0.01 div).

Offset Range – ±25 div, 0.025 div resolution.

Typical Noise (RMS) – 0.022 div.

Input Impedance – 50 Ω ±0.5%; VSWR ≤1.45:1 @10 mV/div, DC to 1 GHz; VSWR ≤1.25:1 for deflection factors ≥ 20 mV/div, DC to 1 GHz.

Disconnect Threshold – 5 Vrms typical (DC to 100 MHz).

Input Coupling Modes – AC, DC, OFF.

AC Coupled Low Frequency – –3 dB point; 1 kHz or less from 50 Ω source.

Max Input Voltage – DC Coupled: 25 V pk or 5 Vrms. AC Coupled: ±100 VDC additional. Input coupling is set to off when coupled signal exceeds safe limits. Manual reset by selecting either AC or DC coupling.

11A52 Two-Channel Amplifier Characteristics

Bandwidth –

Volts/div	Bandwidth (MHz)
>10 mV	600
5 to 9.95 mV	400
2 to 4.98 mV	250
1 to 1.99 mV	200

Calibrated Deflection Factors – Coarse: 1 mV to 10 V/div in 1-2-5 steps. Fine: between coarse steps in 1% increments of next more sensitive coarse step.

Accuracy – ΔVolts DC accuracy:
With 11400: ±(0.8% +0.01 div).
With DSA 600: ±(0.9% +0.02 div).
DC Balance, 1 to 99.5 mV/div: ±(0.2 mV + 0.10 div).
Offset Accuracy, 1 to 99.5 mV/div (±1 V range): (0.15% + 0.4 mV).

Offset Range – 1 to 99.5 mV/div: ±1 V; Resolution: 25 µV. 100 mV to 0.995 V/div: ±10 V; Resolution: 250 µV.1 to 10 V/div: ±100 V; Resolution: 2.5 mV.

Overdrive Recovery – 1 to 99.5 mV/div: To within ±(0.2% +0.1 div) within 20 ns from ±2 V step.

Typical Noise (RMS) – 1 to 1.99 mV/div: 0.087 div. 2 to 4.98 mV/div: 0.04 div. 5 to 9.95 mV/div: 0.02 div. 10 mV to 10 V/div: 0.012 div.

Input Impedance – 50 Ω ±0.5%; VSWR: < 1.3:1 DC to 500 MHz.

Input Coupling Modes – AC, DC, and OFF.

AC Coupled Low Frequency – –3 dB point; 1 kHz or less from 50 Ω source.

Max Input Voltage – DC Coupled: 25 V pk or 5 Vrms. AC Coupled: ±100 VDC additional. Input coupling is set to off when coupled signal exceeds safe limits. Manual reset by selecting either AC or DC coupling.

ORDERING INFORMATION

11A72
Two-Channel Vertical Amplifier **$4,595**
Includes: User Reference (070-7255-00), Service Reference (070-7257-00).
Opt. 25 – Includes two P6231 Bias-offset probes. ..... **+$1,300**
Opt. 26 – Includes two P6203 Bipolar probes ..... **+$2,400**
Opt. 27 – Includes two P6204 Active probes. ..... **+$2,900**
Opt. 28 – Includes two P6217 Active probes. ..... **+$6,990**

11A52
Two-Channel Vertical Amplifier **$3,295**
Includes: User Reference (070-6114-00), Service Reference (070-6786-00).
Opt. 25 – Includes two P6231 Bias-offset probes. ..... **+$1,300**
Opt. 26 – Includes two P6203 Bipolar probes ..... **+$2,400**
Opt. 27 – Includes two P6204 Active probes. ..... **+$2,990**
Opt. 28 – Includes two P6217 Active probes. ..... **+$6,990**

WARRANTY-PLUS SERVICE OPTIONS
Opt. M7 – Calibration Service
11A72 ..... **+$175**
11A52 ..... **+$145**

Opt. M9 – Repair Protection
11A72 ..... **+$325**
11A52 ..... **+$275**

Opt. Q2 – Customer Site HW Service
11A52 ..... **+$375**

PROBES
See Page 423 for complete descriptions and full line of probes.

Active –
1 GHz, 1.9 pF/10 MΩ, 1.5 m. Order P6204 ..... **$1,495**
4 GHz, 0.4 pF/100 kΩ, 1 m. Order P6217 ..... **$3,495**
750 MHz, 2 pF/1 MΩ, 1.5 m. Order P6205 ..... **$495**

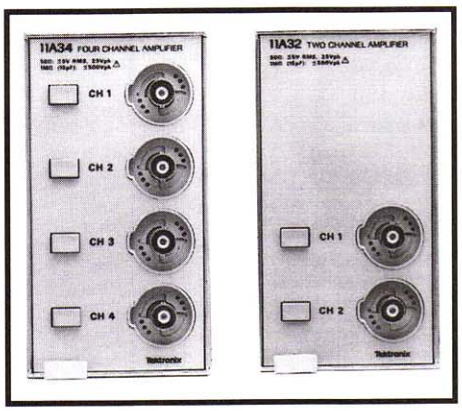
Differential – 100 MHz, active differential, 6ft. Order P6046 .. **$2,195**

50 Ω Divider – Divider probe set includes two tips 10X, 100X 3.5 GHz, 1 pF/500 Ω, 3 GHz, 1 pF/5000 Ω, 1.5 m. Order P6156 with Opt 25 ..... **$325**

Current –
25 kHz to 1 GHz. Order CT-1 ..... **$290**
1.2 kHz to 200 MHz. Order CT-2 ..... **$250**

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

Plug-In Amplifiers
High Impedance



11A32 and 11A34 Amplifiers

The 11A32/11A34 amplifiers offer switchable 1 MΩ/50 Ω input impedance, fast overdrive recovery and wide offset ranges. The 11A32 is a two-channel unit, and the 11A34 is a four-channel unit.

Two built-in four-pole bandwidth-limit filters (100 MHz and 20 MHz) may be activated to reduce unwanted high-frequency noise at 24 dB/octave for each channel.

Both coarse and fine deflection-factor steps are fully calibrated. At 1 mV/div, the calibrated DC offset can be set with a resolution of 25 μV and a range of ±1 V (equivalent to 16 bits), giving an effective screen height of 2000 divisions and permitting absolute DC measurement accuracies to ±0.4%.

Characteristics

Number of Channels – 11A32: Two; 11A34: Four.

Calibrated Deflection Factors – Coarse steps: 1 mV to 10 V/div in 1-2-5 sequence. Fine steps: Between coarse steps in 1% increments of next more-sensitive coarse step.

Bandwidth –

Volts/div	11A32 Bandwidth (MHz)	11A34 Bandwidth (MHz)
>10 mV	400	300
5 to 9.95 mV	350	250
2 to 4.98 mV	250	200
1 to 1.99 mV	200	150

Accuracy – ΔVolts DC accuracy: With 11400: ±(0.9% + 0.012 div). With DSA 600: ±(1.0% + 0.02 div). DC Balance, 1 to 99.5 mV/div: ±(1.0 mV + 0.10 div). Offset Accuracy, 1 to 99.5 mV/div (±1 V range): (±0.2% + 0.5 mV). For absolute DC accuracy of single-point measurements using offset, add the Offset Accuracy and DC Balance terms.

Offset Range – 1 to 99.5 mV/div: ±1 V; Resolution: 25 μV. 100 mV to 0.995 V/div: ±10 V; Resolution: 250 μV. 1 to 10 V/div: ±100 V; Resolution: 2.5 mV.

Overdrive Recovery – 1 to 99.5 mV/div: To within ±(0.3% +0.2 div) within 50 ns from ±2 V step. 100 to 995 mV/div: To within ±1% within 50 ns from ±20 V step. 1 to 10 V/div: To within ±1% within 50 ns from ±200 V step.

Typical Noise (RMS) – 1 to 1.99 mV/div: 0.12 div.
2 to 4.98 mV/div: 0.06 div.
5 to 9.95 mV/div: 0.025 div.
10 mV to 10 V/div: 0.014 div.

Input Impedance – Switchable: 1 MΩ in parallel with 15 pF, or 50 Ω ±0.5%

Input Coupling Modes – AC, DC, and OFF.

AC Coupled Low Frequency – –3 dB point, driven from 50 Ω source: less than 10 Hz.

Maximum Input Voltage – 1 MΩ mode: 500 V (DC + peak AC). 50 Ω mode: The input impedance is switched to 1 MΩ when the input signal exceeds safe limits. Manual reset by re-selecting 50 Ω input impedance.

11A32/11A34

- DC to 400 MHz Bandwidth (11A32)
- Two Channels (11A32) or Four Channels (11A34)
- 1 mV to 10 V/Div Calibrated Deflection Factors in 1% Increments
- Switchable 50 Ω or 1 MΩ Input Impedance
- High-Resolution Calibrated DC Offset
- Fast Overdrive Recovery

Excellent, medium bandwidth amplifiers. They offer switchable 1 MΩ/50 Ω input impedance, fast overdrive recovery, and wide offset range.

ORDERING INFORMATION

11A34
Four-Channel Vertical Amplifier **$4,595**
Includes: User Reference (070-5921-01), Service Reference (070-6785-02).

11A32
Two-Channel Vertical Amplifier **$2,695**
Includes: User Reference (070-5922-01), Service Reference (070-6782-03).

Opt. 3P – (11A32, 11A34) Includes P6408 Word, Recognizer/Trigger Probe ..... **+$425**
Opt. 22 – (11A32) Includes two P6134C probes ..... **+$440**
Opt. 23 – (11A34) Includes four P6134C probes ..... **+$880**

WARRANTY-PLUS SERVICE OPTIONS
Opt. M7 – Calibration Service
11A32 ..... **+$125**
11A34 ..... **+$195**

Opt. M9 – Repair Protection
11A32 ..... **+$175**
11A34 ..... **+$375**

Opt. Q2 – Customer Site HW Service
11A32 ..... **+$275**
11A34 ..... **+$475**

PROBES
See page 423 for complete descriptions and full line of probes.

Active – 1 GHz, 1.9 pF/10 MΩ, 1.5 m. Order P6204 ..... **$1,495**
750 MHz, 2 pF/1 MΩ, 1.5 m. Order P6205 ..... **$449**

Differential – 100 MHz, active differential, 6 ft. Order P6046 ..... **$2,195**

High Voltage –
120 MHz, 1500 V, 2.5 pF/10 MΩ, 9 ft. Order P6009 ..... **$265**
75 MHz, 20 kV, 3.0 pF/100 MΩ, 10 ft. Order P6015A Opt. 1R **$950**

General Purpose –
1X, 15 MHz, 100 pF/1 MΩ, 2m. Order P6101B **$60**
10X, 400 MHz, 11.3 pF/10 MΩ, 1.5 m. Order P6134C **$220**
1X/10X Switchable, 1X: 6 MHz, 105 pF/1 MΩ, 6 ft; 10 X: 200 MHz, 14 pF/10 MΩ, 6 ft. Order P6063B **$320**

Current –
120 Hz – 60 MHz, 7.5A peak. Order P6021 ..... **$545**
935 Hz – 120 MHz, 3A peak. Order P6022 ..... **$595**
1.2 kHz – 200 MHz. Order CT-2 ..... **$250**
DC – 50 MHz System. Includes AM503A, A6302. Order AM503S **$2,595**

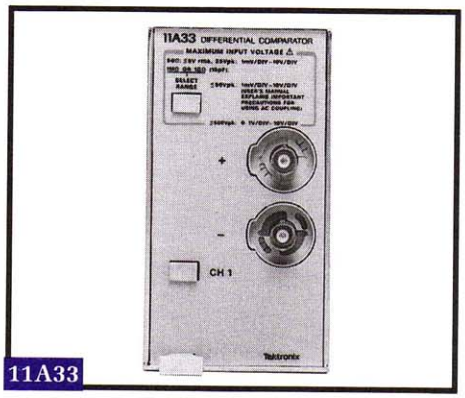
To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

Plug-in Amplifiers
Differential Comparator

Balanced (+ and –) input for applications requiring rejection of common mode signal.

11A33

- DC to 150 MHz Bandwidth
- 1 mV to 10 V/Div Calibrated Deflection Factors in 1% Increments
- Very High Resolution, Calibrated DC Offset 16,000-Division Effective Screen Height
- Differential DC Offset range of ±1 V at 1 mV/Div
- High Common-Mode Rejection
- Fast Overdrive Recovery from Large Input Signals
- Selectable 50 Ω, 1 MΩ, or 1 GΩ Input Impedance



11A33 Differential Comparator

As a differential amplifier, the 11A33 provides a balanced (+ and –) input for applications requiring rejection of a common-mode signal. The unit can reject up to 8 V pk-pk of common-mode signal with a CMRR of 10,000:1 from DC to 1 MHz, (derating to 500:1 at 20 MHz 1 Vp-p) at a deflection factor setting of 1 mV/div. Differential DC offset is available to null out DC offsets between the two inputs. This offset capability can be used with DC coupling at 1 mV/div to measure a bipolar transistor's Vbe change from self-heating caused by signal changes.

As a comparator amplifier the 11A33 loses its differential capability, but provides an accurate (0.15%) positive or negative internal offsetting voltage covering the amplifier's common-mode signal range. This mode is also known as slide-back comparison. A signal of up to ±8 V may be applied to an input at a deflection factor setting of 1 mV/div, and with an opposing VC (offset voltage), small segments of the signal may be observed.

Characteristics

Number of Channels – One.

Bandwidth – DC to 150 MHz (DC to 120 MHz at 1 mV/div).

Calibrated Deflection Factors – Coarse steps: 1 mV to 10 V/div in 1-2-5 sequence. Fine steps: Between coarse steps in 1% increments of next more-sensitive coarse step.

VC Range – 1 to 99.5 mV/div: ±8 V; Resolution: 25 µV; 100 mV to 0.995 V/div: ±80 V; Resolution: 250 µV. 1 to 10 V/div: ±500 V; Resolution: 2.5 mV.

Deflection Factor	1 mV to 99.5mV/div	100 mV to 0.99 V/div	1 V to 10 V/div
Common-mode Signal range	±8 V	±80 V	±500 V
Differential DC Offset range	±1 V	±10 V	±100 V
VC range	±8 V	±80 V	±500 V

Accuracy – ΔVolts DC accuracy: With 11400: ±(0.9% +0.01 div). With DSA 600: ±(1.0% +0.02 div). DC Balance, 1 to 99.5 mV/div: ±(0.5 mV +0.10 div). Differential DC Offset Accuracy, 1 to 99.5 mV/div: ±(0.25% + 0.7 mV). VC Accuracy, 1 to 99.5 mV/div (8 V range): ±(0.15% + 0.6 mV). For absolute DC accuracy of single point measurements using VC, add the VC Accuracy and DC balance terms.

Differential DC Offset Range – 1 to 99.5 mV/div: ±1 V; 100 mV to 0.995 V/div: ±10 V; 1 to 10 V/div: ±100 V.

Overdrive Recovery – Recovers to within 0.25% of overdriving signal within 40 ns; to within 2 mV in 100 µs; to within 1 mV in 300 µs. Conditions: 1 to 99.5 mV/div; Overdriving signal steps to 0.0 V from ±8.0 V; Slew rate ≤ 0.5 V/ns.

Typical Noise (RMS) – 1 to 1.99 mV: 0.24 div. 2 to 4.98 mV: 0.12 div. 5 to 9.95 mV/div: 0.05 div. 10 mV to 10 V/div: 0.03 div.

Common-Mode Rejection Ratio – 1 to 99.5 mV/div: 10,000:1, DC to 1 MHz; 2000:1 at 5 MHz (8 Vp-p signal). 100 mV to 0.995 V/div: 1000:1, DC to 1 MHz; 100:1 at 10 to 20 MHz (30 Vp-p signal). 1 to 10 V/div: 500:1, DC to 250 kHz (100 Vp-p signal).

Input Impedance – 50 Ω, 1 MΩ in parallel with 15 pF, or 1 GΩ in parallel with 15 pF from 1 to 99.5 mV/div.

Input Coupling Modes – DC, AC, VC, and OFF for each input. VC Coupling internally connects an amplifier input to the comparison voltage.

Max Input Voltage – 1 MΩ mode: 1 to 99.5 mV/div: 50 V (DC + peak AC); 0.1 to 10 V/div: 500 V (DC + peak AC). (At 1 to 99.5 mV/div, derate maximum input voltage at 20 dB/decade above 3 MHz; at 100 mV to 10 V/div, derate maximum input volt-age at 20 dB/decade above 1 MHz). 50 Ω mode: The input impedance is switched to 1 MΩ when the input signal exceeds safe limits. Manual reset by re-selecting 50 Ω input impedance. LF Step Response aberrations: 0.1 V/div -110 V/div: less than ±1% after the first 20 ns of input step.

ORDERING INFORMATION

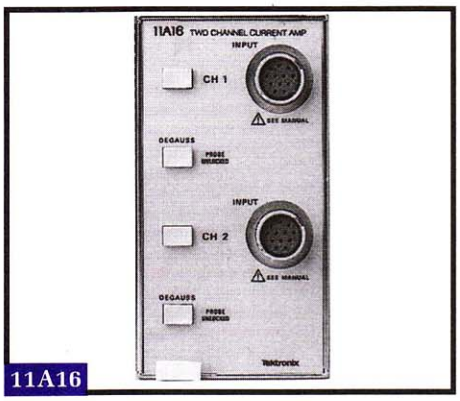
11A33
Differential Comparator **$3,995**
Includes: User Reference (070-6119-00), Service Reference (070-6784-01).
Opt. 24 – Includes a P6135A probe pair. ..... **+$695**

WARRANTY-PLUS SERVICE OPTIONS
Opt. M7 – Calibration Service ..... **+$135**
Opt. M9 – Repair Protection ..... **+$250**
Opt. Q2 – Customer Site HW Service ..... **+$350**

PROBES
See Probe Section on page 423 for complete descriptions and full line of probes.
Matched Pair – 150 MHz, differential pair, 1.5 m.
Order P6135A **$695**

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

Plug-In Amplifiers
Current Amplifier



11A16 Amplifier

The 11A16 is a two-channel current amplifier plug-in designed to operate with the A6302 and A6303 current probes. With the 11A16 you get a versatile and powerful current analysis and measurement system. It provides direct readout of current levels, and calibration – including timing deskew – of the probe path. Deskewing the current channel means you can now make instantaneous power measurements with higher accuracy than ever before. And those measurements can be programmed over the GPIB for a totally automated system.

Characteristics

(With A6302 Current probe.)

Number of Channels – Two.

Bandwidth – 50 MHz (limited by probe).

Rise Time – 7 ns or less.

Deflection Factor – 1 mA/div to 2 A/div in 1-2-5 sequence.

Offset Range – 1 mA/div to 99.5 mA/div: ±1 A; Resolution: 25 µA. 0.1 A/div to 2 A/div: ±10 A; Resolution: 0.025 div.

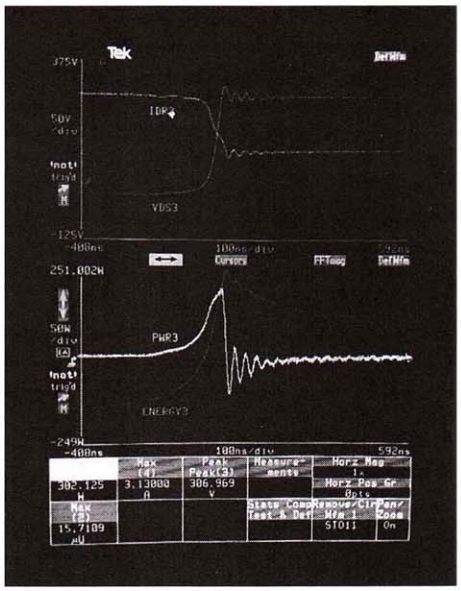
Input Coupling Modes – AC, DC, and OFF.

ENVIRONMENTAL CHARACTERISTICS

Temperature – Operating: 0° to 50°C; Non-operating: – 40° to +75°C.

Altitude – Operating: to 4.5 km (15,000 ft); Non-operating: to 15 km (50,000 ft).

Mil Specs – MIL-T-28800C, Type III, Class 5.



Make accurate, high-bandwith power measurements and energy calculations with the 11A16 Programmable Current Amplifier and 11A33 Differential Comparator. Current and Voltage maintain their proper phase relationship to 50 MHz.

With a sensitivity range of 1 mA/div to 2 A/div (with the A6302 probe) the 11A16 supports a wide variety of applications from medical monitors to machine control to power systems. The 11A16 is an excellent tool for power supply designers. With it, the engineer can make simultaneous measurements on current and voltage waveforms, and use the waveform math capability of the 11000 Series and DSA 600 Series mainframes to calculate instantaneous power. You can verify power circuit design or monitor variations in power use by your target system.

11A16

- Two Separate Channels
- 50 MHz Bandwidth at Probe Tip
- Automatic Deskew, Including Probe, for High Accuracy Power Measurements
- Programmability via IEEE 488.1 (GPIB) and RS-232
- Increased Accuracy from On-Board Amplitude Calibration
- Fully Compatible with 11000/ DSA Series
- Full Use of All 11000 Series Measurements
- Compatible with Tektronix A6302 and A6303 Current Probes
- One Button Probe Degaussing and Offset Adjustment
- Bandwidth Limiting
- AC or DC Coupling

Fully integrated measurements of AC + DC current. Excellent power measurement system when combined with 11A33 differential amplifier.

ORDERING INFORMATION

11A16

Two-Channel Current Amplifier **$3,195**

Includes: User Reference (070-7763-00), Service Reference (070-7764-00), Current Loop Adapter (015-0601-00), Voltage Converter (015-0598-00).

Opt. 20 – Includes two A6302 probes ..... **+$1,550**

WARRANTY-PLUS SERVICE OPTIONS

Opt. M7 – Calibration Service ..... **+$130**

Opt. M9 – Repair Protection ..... **+$260**

Opt. Q2 – Customer Site HW Service ..... **+$360**

CURRENT PROBES

DC to 50 MHz, 0-10.5A (DC to pkAC). Order A6302 ..... **$775**

DC to 15 MHz, 0-52.5A (DC to pkAC). Order A6303 ..... **$1,420**

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

11T5H
11A34V

Plug-In Amplifiers
Video Trigger/Amplifier

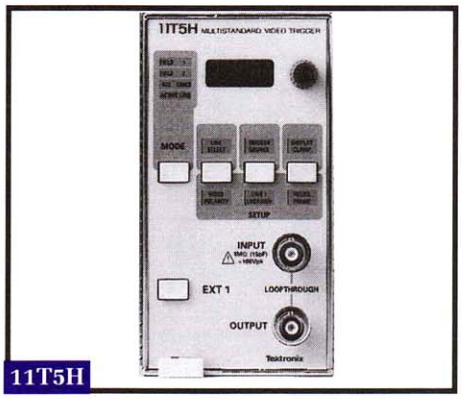
High bandwidth amplification and specialized triggering for a wide variety of video systems.

11T5H

- Trigger on Individual Lines – Up to 1280 Lines/Frame
- Compatible with All Major TV Standards – Including HDTV
- Fully Programmable via GPIB
- Easy-to-Use Controls
- Operates with Companion 11A34V High Bandwidth Video Amp for a Total System

11A34V

- Four 300 MHz Channels
- 75 Ω/1 MΩ Switchable Input Impedance
- Companion Amplifier for 11T5H Multi-Standard Video Trigger



11T5H

11T5H Multi-Standard Video Trigger

The new 11T5H Multi-Standard Video Trigger plug-in offers triggering capability for high performance video applications. It brings the measurement power of the 11000 Series to TV/video applications for the first time.

With the 11T5H, all major TV standards can be triggered on, including new HDTV standards with their high line count and tri-level sync. The 11T5H can handle line rates up to 1280 lines/frame. Engineers designing the latest HDTV components, medical imaging systems, high resolution graphics monitors, or other state-of-the-art video equipment need the power of the 11000 Series with the 11T5H Multi-Standard Video Trigger.

Characteristics

Modes – Field 1, Field 2, All Lines, Active Lines

Line Select Range – 1 to 1280 lines or maximum of format

Trigger Jitter (Typical) – 3 ns

Input/Output – EXT 1 input, loopthrough output

Trigger Source – Selectable from EXT 1 (11T5H front panel), L1, L2, C1, C2 from compatible companion amplifier plug-in.

ENVIRONMENTAL CHARACTERISTICS

Temperature – Operating: 0 to +50°C, Non-operating: –40 to +75°C.

Humidity – Operating and Non-operating: meets MIL-T-28800C, Type III, Class 5 as described in 3.9.2.2 and 4.5.5.1.2.2.

Altitude – Operating: to 4,570 m (15,000 ft.); Non-operating: to 15,200 m (50,000 ft.).

11A34V High Bandwidth Video Amplifier

The 11A34V is specially designed as a companion amplifier for the 11T5H Multi-Standard Video Trigger to meet the needs of TV/video engineers designing medical imaging equipment. HDTV components, high-resolution graphics monitors, and other video systems will find the special features of the 11A34V bring new power to their design tasks. Features include convenient 75 Ω/1 MΩ switchable input impedance, display clamping and trigger source signals with the 11T5H Video Trigger. The 11A34V also offers the same high performance of the 11A34: four 300 MHz bandwidth channels, fast overdrive recovery, wide offset and dynamic range, and 1 mV/div to 10 V/div sensitivity settings.

TV and video designers will find the 75 Ω input setting convenient for connection to their circuitry. The 11A34V's for input channels make it easy to view components video signals – R, G, and B can each have a separate input. The 11A34V provides the performance needed for state-of-the-art TV/video design.

ORDERING INFORMATION

11T5H
Multi-Standard Video Trigger **$2,495**
Includes: User Reference (070-7961-00), Service Reference (070-7962-00).

11A34V
High Bandwith Video Amplifier **$4,995**
Includes: User Reference (070-8178-00), Service Reference (070-8179-00).

WARRANTY-PLUS SERVICE OPTIONS

Opt. M7 – Calibration Service
11T5H ..... **+$125**
11A34V ..... **+$215**

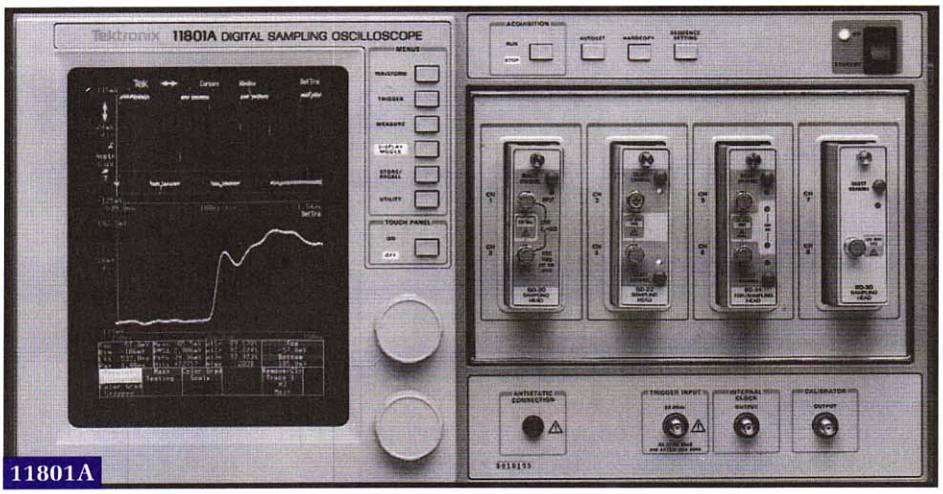
Opt. M9 – Repair Protection
11T5H ..... **+$265**
11A34V ..... **+$410**

Opt. Q2 – Customer Site HW Service
11A34V ..... **+$525**

PROBES
See Probe Section on page 423 for complete descriptions and full line of probes.

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

Digital Sampling Oscilloscope



11801A Digital Sampling Oscilloscope

The 11801A digital sampling oscilloscope offers the highest bandwidth and time resolution of the 11000 Series. In addition to the easy-to-use, touch-screen user interface and powerful automatic measurement system common to all 11000 Series instruments, the 11801A adds single-ended and differential TDR and TDT, timing resolution to 0.01 ps, and up to 50 GHz bandwidth (depending on the sampling head used). This unmatched performance and feature set makes them ideal for semiconductor device testing; TDR characterization of circuit boards, IC packages, and cables; and high-speed digital, data-communication measurements.

- The 11801A accepts up to four, dual-channel SD Series sampling heads and is expandable to 136 channels of acquisition and TDR using SM-11 Multi-Channel Units.

RESOLUTION AND REPEATABILITY

The state-of-the-art digital time base in the 11801A provides unmatched timing resolution, with sample intervals to 10 femtoseconds (0.01 ps) and measurement repeatability to 1 ps. In addition, the vertical system provides 8 bits of vertical resolution at all deflection factors (78 µV LSB at 2 mV/div). Powerful on-board waveform processing allows expansion with averaging to sensitivities in the 100 µV/div range and beyond.

FASTEST ACQUISITION

The 11801A, with its multiprocessor-based architecture and high-speed analog, error-sample feedback-loop technology, has the highest sample rate of any sampling oscilloscope. The 200 kHz sampling rate gives the 11801A a "real-time" feel for waveform controls and allows high-speed data capture for histograms and automated measurements.

11801A

- 8.8 ps Rise Time
- 10 femtosecond Equivalent-Time Sampling Interval
- 200 kHz Sampling Rate
- "Real-Time" Feel for Waveform Control
- Optical-to-Electrical (O/E) Capability
- Modular Architecture
- Fully Programmable
- Easy to Use
- 8 Channels, Expandable to 136
- TDR/TDT Capability
- Automatic Measurements
- Waveform Processing
- High Frequency Sampling Heads (40 & 50 GHz) for Multi-GHz Sampling Requirements
- 2.5 GHz to 50 GHz BW
- 3 GHz High Impedance Probe Sampler

High resolution capable of viewing very fast digital signals.

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

GPIB IEEE-488

The 11801A Series complies with IEEE Standard 488.1-1987, and with Tektronix Standard Codes and Formats.

Digital Sampling Oscilloscope

MODULARITY MAKES ROOM FOR GROWTH

In the Tektronix tradition, the 11801A can be tailored through modular plug-in sampling heads for a variety of applications. Modularity also offers a path for growth and expansion as new sampling heads become available. For example, for applications requiring superior noise performance, the SD-22 Sampling Head offers two channels of acquisition at 12.5 GHz with 450 µV (typical) of noise. High bandwidth acquisition and TDR are available in the SD-24 sampling head, which offers two channels with 20 GHz bandwidth and two polarity-selectable TDR step generators. The SD-14 Probe Sampler is the latest addition to the sampling head family. It is a two channel probe sampler with 3 GHz bandwidth, 100 kΩ input impedance, and a 0.45 pF capacitance. The SD 32 is a 50 GHz single channel sampling head for 2.4 mm coax connector input sampling requirements. The SD Series of sampling heads currently includes 10 heads.

AUTOMATED MEASUREMENTS MAKE IT EASY

The 11801A offers a comprehensive, accurate, and automatic measurement system. Up to six measurements can be displayed on screen at any time, all updated continuously. Any number of measurements may be made over the GPIB or RS-232-C interfaces.

For the first time in the industry, you now can make automatic jitter and noise measurements using the statistical measurement mode. Statistical measurements allow automatic pulse parameter measurements on random signals such as eye-diagrams and allow you to make stable and accurate measurements even in the presence of jitter and noise.

All measurement parameters are user-controllable and measurement levels may be set in relative (i.e., percentage) or absolute terms. Measurements are also fully annotated so there is no question about which part of the waveform is used for making the measurements.

Measurements include: amplitude measurements, such as mean, rms, p-p, and overshoot; timing measurements, such as width, propagation delay, and phase; and energy measurements, that provide direct area or energy results! Measurement statistics are also available to evaluate the stability of any measurement result.

For large channel count applications where throughput is a prime consideration, dedicated time measurement hardware can be used to make precise timing measurements on many channels in parallel – over 50 measurements per second. This hardware is duplicated for each sampling head in the mainframe and SM-11, providing maximum throughput even in large channel-count applications.

ON-BOARD WAVEFORM PROCESSING

The extensive on-board waveform processing capability of the 11801A not only provides smooth "real-time" update rate and control response, it also allows complex waveform calculations to be performed and displayed in the same continuously updated fashion.

Calculated waveforms can be as simple as addition of two channels, or more complex, from basic operators (+, –, x, ÷), to specialized math functions such as square root, differentiate, log, envelope, and filter. Calculations can include acquired waveforms, stored waveforms, and constants.

All measurement functions, except hardware measurements, are allowed on calculated traces. In addition, the instrument can be set to stop acquisition after certain conditions, such as when a specified number of averages have been completed.

WINDOWING SHOWS THE DETAILS

The 11801A offers another first for sampling oscilloscopes – windows. Similar to the delayed sweep on conventional oscilloscopes, windows allow viewing a long interval on one trace while examining the details of a section of the waveform on a second trace.

Up to seven windows can be created on a single main trace, each with independent positions. The instrument can even be programmed to automatically locate a window on a specified transition within the main waveform. Like the other oscilloscopes in the 11000 Series, windows in the 11801A are actually re-acquired with a higher resolution than the main waveform – not just digitally expanded from the main trace, as in some lower performance instruments.

Digital Sampling Oscilloscope

TIME DOMAIN REFLECTOMETRY (TDR)

With the SD-24 Dual-Channel TDR/Sampling Head, the 11801A offers full 20 GHz acquisition and unmatched TDR performance on up to 136 channels. Each channel has an independent polarity-selectable (positive-going or negative-going) TDR step generator. The TDR outputs can also be precisely matched at a reference plane providing the only true integrated differential TDR system available today. Differential TDR offers an accurate picture of the performance of balanced or unbalanced differential systems, such as twisted pair cables, differential microstrips, or differential inputs in active devices.

The step generator of the SD-24 also represents state-of-the-art technology, offering unmatched 35 ps reflected rise time (the rise time of a reflection from a short circuit, including the acquisition rise time of 17.5 ps) with the flattest step in the industry. TDR is also simple to use with one-touch preset functions for both single-ended and differentia! TDR. There is direct readout of impedance in rho and ohms as well as readout of one-way or two-way distance in meters, feet, or inches.

The 11801A allows real-time viewing of the TDR response to a user-selected rise time with the filter function. Simply enter the filter rise time, and the 11801A displays a live trace that shows the response at that rise time. Waveform math can also be used to subtract a reference trace acquired with a 50 Ω terminator for removal of unwanted aberrations due to cabling and fixturing.

HARNESSING THE POWER

Virtually all operations of the 11801A are through the touch-sensitive front-panel. A simple three-level menu structure with pop-up menus and two control knobs provide simple interaction with all functions. In addition, common functions, such as volts/division and time/division are always selectable through on-screen icons – so these functions are always available. The two multi-function knobs allow controlling two related parameters, such as volts/division and offset, for less button pushing.

Autoset provides a convenient, fast method for displaying a signal on the 11801A. Just select a channel and press autoset. Usually autoset is complete in less than two seconds.

ATE APPLICATIONS

The 11801A functions are completely programmable through the IEEE Standard 488 (GPIB) and RS-232-C interfaces. In addition, up to 10 complete instrument settings may be stored in nonvolatile memory on-board for quick recall over the external interfaces or through the front panel. Documentation is simple using the flexible hardcopy features of the 11801A. Full screen printouts, including time/date stamp can be printed on a variety of devices including dot matrix, laser printers, pen plotters and ink jet.

SOFTWARE SUPPORT

All the 11000 Series software products are compatible with the 11801A. See page 278 for more information on software for the 11000 Series.

11801A DIGITAL SAMPLING OSCILLOSCOPE EXPANSION

The 11801A supports to eight acquisition channels in the mainframe and provides expansion capability for up to 136 channels using four SM-11 Multi-Channel Units. This large number of channels allows parallel acquisition for very fast pulse parametric testing of high-speed integrated circuits or for supplementing a functional test system while performing AC parametric testing.

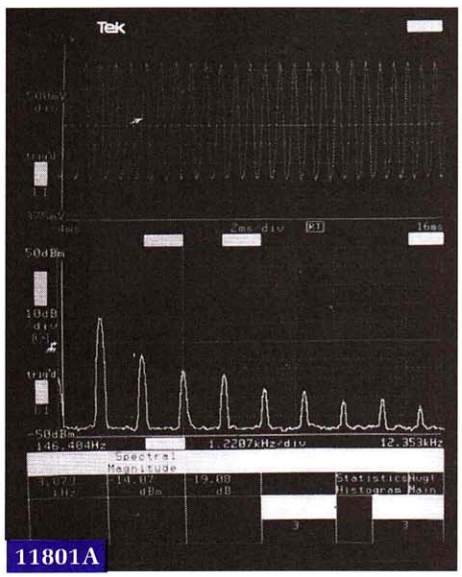
Up to half of the channels can be acquired and measured simultaneously – in a single acquisition cycle. This measurement power is made possible by the multiprocessor architecture used in the 11801A.

The highly parallel acquisition and measurement architecture not only eliminates the need for relay multiplexers, which degrade signal quality and system reliability, but it also makes acquisition and measurement of many channels practical in a production ATE environment. Signal acquisition and TDR measurements can be done with a simple command, with no disconnecting and reconnecting of cables or probes required before acquiring data.

In today's high-speed circuits, testing controlled impedances of circuit board runs, removing cable delays from the device under test, and other transmission-line integrity measurements are critical. In addition, multi-channel TDR allows crosstalk testing on ribbon cables and circuit boards, as well as high throughput single-ended TDR for traditional cable and connector applications. The 11801A with the SD-24 TDR/Sampling head, moves TDR from the position of an occasional tool to an integral part of your measurement strategy.

Continued on next page.

Digital Sampling Oscilloscope



Characteristics

VERTICAL SYSTEM (EXCEPT SD-14)

Rise Time/Bandwidth – Determined by the sampling head used.*1

Vertical Resolution – 8 bits full screen (80 µV LSB at 2 mV/div deflection factor).

Amplifier Gain Accuracy – ±1% of all settings.

Deflection Factors – 2 to 255 mV/div in 1 mV/div increments.

Offset Range – ±2 V.

HORIZONTAL SYSTEM

Main and Window Time Base – 1 ps/div to 5 ms/div, settable in 1-2-5 sequence or in 1 ps increments.

TIME BASE ACCURACY*2

Time interval	Accuracy
≥ 10 ns	0.01% x time interval + 10 ps
1 ns	10 ps
100 ps	5 ps
10 ps	2 ps

Record Length – 512, 1024, 2048, 4096, and 5120 points.

Windows – Any number of window records may be placed on any number of main records, up to a maximum of 8 displayed traces. All window records have the same duration, but may be independently positioned on any main record. The window may be set to automatically track a moving edge on the main record.

Maximum Sample Rate – 200 kHz.

TRIGGER SYSTEM

Trigger Bandwidth – 2 GHz.

Trigger Sensitivity*3 – DC Coupled, 40 mVp-p DC – 200 MHz; 200 MHz – 2.0 GHz increasing linearly to 200 mV; AC Coupled: Attenuates signals below 30 kHz, 40 mVp-p from 30 kHz to 200 MHz, 250 mVp-p at 2 GHz.

Delay Jitter – 2.5 ps +20 ppm of selected delay (rms).

Internal Clock – 100 kHz (drives TDR, Internal Clock Output, and Calibrator).

Trigger Level Range – ±1.0 V (±5.0 V with 10X trigger attenuator activated).

Trigger Input Range – ±1.5 V.

MEASUREMENT SYSTEM

Waveform Processing Functions – Add, subtract, multiply, divide, absolute, average, differentiate, envelope, exponent, integrate, natural log, log, signum, square root, smoothing, and filter.

Measurement Set – Max, min, mid, p-p, mean, rms, amplitude, extinction ratio, overshoot, undershoot, noise*4, rise, fall, frequency, period, prop delay, cross, width, phase, duty cycle, jitter*4, area +, area –, and energy. Measurements are constantly updated; mean and standard deviation available on all measurements.

Measurement Parameters – Proximal, mesial, distal,and start/stop levels: May be set to relative or absolute values.

Cursors – Paired or split dots, vertical bars, and horizontal bars.

POWER REQUIREMENTS

Line-Voltage Ranges – 90 to 132 Vrms, 180 to 250 Vrms.

Line Frequency – 48 to 440 Hz.

Maximum Power Consumption – 214 W.

ENVIRONMENTAL AND SAFETY

Operating Temperature – 0°C to 50°C.

Non-Operating Temperature – –40°C to +75°C.

Altitude, Vibration, Shock, Bench Handling – Operating and Non-Operating: meets MIL-T-28800C, Type III, Class 5.

Safety – Listed UL 1244, CSA Bulletin 556B September 1973, Tektronix self-certification to comply with IEC 348 recommendation.

Electromagnetic Compatibility (except SD-14) – Meets the following requirements of MIL-STD-461C: CE-03 Pt 4 Curve 1, CS-01 Pt 7, CS-02 Pt 4 CS-06 Pt 5, RE-02, Pt 7, RS-01 Pt 4, RS-02 Pt 5, RS-03 Pt 7, (limited to 1 GHz). Meets FCC Part 15, subpart J, Class A.

For Germany: Meets VDE 0871/6.78 Class B.

Humidity – To 95% RH at up to 50°C.

PHYSICAL CHARACTERISTICS

	Cabinet		Rackmount	
Dimensions	**mm**	**in.**	**mm**	**in.**
Width	448	17.6	483	19.0
Height	238	9.4	222	8.8
Depth	599	23.6	550	21.6
Weight ≈	**kg**	**lb**	**kg**	**lb**
Net	22.3	49	23.2	51
Shipping	25.9	57	26.8	59

*1 *See Sampling Head Characteristics on page 90. The 11801A mainframes have no acquisition bandwidth limits.*

*2 *Interpolate linearly between cardinal points.*

*3 *11801A has external trigger only; requires > 40 ns pretrigger or use of DL-11 Delay Lines to view trigger point.*

*4 *Available only in statistical measurement mode.*

Digital Sampling Oscilloscope

ORDERING INFORMATION

11801A
Digital Sampling Oscilloscope **$27,500**
Includes: Tutorial manual (070-8025-00),User Reference (070-8021-00), Programmer Reference (070-7038-01), Command Reference (070-7020-01), Service Reference (070-8024-00), 12 inch SMA-SMA cable, 2 ea. 8 1/2 inch SMA-SMA cable, 1 wrist strap, Power Cord, U.S., 120 V (016-0066-00).

Opt. 1R – Rackmount ..... **+$250**

Opt. 1M – Multi-Channel. Conversion ..... **+$1,000**

Opt. 10 – Deletes the 10 GHz prescalar capability. This does not affect the 2.5 GHz trigger. *1

INTERNATIONAL POWER PLUG OPTIONS

Opt. A1 – Universal Euro 220 V, 50 Hz ..... **NC**

Opt. A2 – United Kingdom 240 V, 50 Hz ..... **NC**

Opt. A3 – Australian 240 V, 50 Hz ..... **NC**

Opt. A4 – North American 240 V, 60 Hz ..... **NC**

Opt. A5 – Switzerland 220 V, 50 Hz ..... **NC**
See Customer Information Section for additional information.

WARRANTY-PLUS SERVICE OPTIONS

Opt. M7 – Calibration Service ..... **+$505**

Opt. M9 – Repair Protection ..... **+$615**

Opt. Q2 – Customer Site HW Service ..... **+$2,010**

SOFTWARE
See Software Section for complete description.

11000 Series/IBM PC Utility Software – Order S47P108 ..... **$449**

EZ-TEST – Order S45F030 ..... **$995**

SPD Signal Processing & Display Software
Order S3FG130 ..... **$995**

Lab Windows™ – Order S3FG910 ..... **$695**

PROBES
See page 423 for complete descriptions and full line of probes.

Low-Z Probes (50 Ω input)
10X, DC – 9.0 GHz. Order P6150 ..... **$995**

Active Probes (requires 1103 power supply) –
10X, DC – 1 GHz, ≥10 MΩ input impedance, 1.9 pF.
Order P6204 ..... **$1,495**
10X, DC – 4 GHz, ≥100 kΩ input impedance, 0.4 pF.
Order P6217 ..... **$3,495**

Current Probe – (requires BNC to SMA Adapter)
DC – 50 MHz, 0-20 A (DC + peak AC). Order AM503S **$2,595**
DC – 15 MHz, 0-100 A (DC + peak AC). Order AM503S Opt. 03 ..... **$3,240**
25 kHz-1 GHz, max current of 0.5 A rms. Order CT-1 ..... **$290**

Optical-to-Electrical Converters – (See page 226)
DC – 6.4 GHz, 1000-1700 nm. Order SD42 ..... **$3,995**
DC – 1 GHz, 1100-1700 nm. Order P6703A *1
DC – 700 MHz, 450-1050 nm. Order P6701A *1
DC – 300 MHz, 1000-1700 nm, High Gain. Order P6713 ..... *1
DC – 250 MHz, 450-1050 nm, High Gain. Order P6711 ..... *1

ADDITIONAL ACCESSORIES

Cart – Instrument cart with tilt tray, drawer, power strip.
Order K217S **$780**

Cables – GPIB, 2 m. Order 012-0991-00 ..... **$170**
RS-232-C, 10 ft. Order 012-0911-00 ..... **$100**
Centronics, 10 ft. Order 012-0555-00 ..... *1

Blank Panels – Sampling Head. Order 200-3395-00 ..... **$0.85**

HARD COPY OUTPUT PRINTER

4-color pen plotter – Order HC100 ..... **$1,075**

Color ink-jet printer – Order 4696 ..... **$1,795**

CALIBRATION STEP GENERATOR

U.S –. Order 067-1338-00 ..... **$5,490**
Includes: Instruction sheet; SMA to female; short-circuit termination.

Universal European – (240 V, 50 Hz). Order 067-1338-01 ..... **$5,490**

UK – (240 V, 50 Hz) Order 067-1338-02 ..... **$5,490**

Australia – (240 V, 50 Hz). Order 067-1338-03 ..... **$5,490**

Switzerland – (240 V, 50 Hz). Order 067-1338-05 ..... **$5,490**

Japan – (100 V, 50-60 Hz). Order 067-1338-06 ..... **$5,490**

ADDITIONAL ACCESSORIES
The following are accessories for the CSA 803, SD-Series heads, and SM-11, unless specified otherwise.

SMA Accessory Kit – Order 020-1693-00 ..... **$2,195**
Includes: 2 each 2X and 5X attenuators; 2 each SMA Terminations, Male Short Circuit, Female Short Circuit, Male 50 Ω, Female 50 Ω, 2 each 50 Ω Signal Cables (2 ns), 2 each 500 ps Semi-Rigid Cable, 2 each Male-to-Male adapters, 2 each SMA Male-to-BNC Female, 2 each Female-to-Female, 1 each 50 Ω Power Divider, 1 each Combination Wrench (.312, 6 point).

3.5 mm Accessory Kit – Order 020-1692-00 ..... **$7,400**
Includes: 1 each 50 Ω Reference Air Line, 1 each Male-to-Male Adapter, 1 each Female-to-Female Adapter, 1 each 26.5 GHz 50 Ω Terminator (Male), 1 each 26.5 GHz 50 Ω Terminator (Female), 1 each 26.5 GHz Short Circuit (Male), 1 each 26.5 GHz Short Circuit (Female), 2 each 50 Ω Terminators (6 dB 26.5 GHz, 2.9 mm), 2 each 50 Ω Terminators (20 dB 26.5 GHz, 2.9 mm), 1 each Power Divider (26.5 GHz, 2.9 mm), 2 each Signal blews (2 ns, Male-to-Male), 2 each Signal Cables (500 ps, Male-to-Male, 2.9 mm semi-rigid), 1 each Torque Wrench, 1 each Combination Wrench (0.312, 6 pint), 1 each Combination Wrench (0.281, 6 point).

2X Attenuator – SMA Male-to-Female. Order 015-1001-00 ..... **$185**

5X Attenuator – SMA Male-to-Female. Order 015-1002-00 ..... **$175**

Power Divider – Order 015-1014-00 ..... **$300**

Blank Sampling Head – Order 200-3395-00 ..... **$0.85**

ECL Terminator – Provides the bias and termination for ECL device outputs. At 10 GHz bandwidth and 1% precision attenuation, accurate AC and DC measurements are ensured.
Attenuation: 10X ±1.0% @ DC, 20 dB ±3 dB, DC to 10 GHz.
Abberations: ±3% max with 100 ps rise time.
Order 015-0558-00 ..... **$910**

DC Block (Coupling Capacitor) – Order 015-1013-00 ..... **$315**

Slip-On Connector – Order 015-0553-00 ..... **$38**

Connector Savers – SMA: Order 015-0549-00 ..... **$185**
APC: Order 015-0552-00 ..... **$245**

CABLES AND EXTENDERS

Sampling Head Extender Cables – (1 m). Order 012-1220-00 ..... **$710**
(2 m). Order 012-1221-00 ..... **$735**

Acquisition Extender – Order 067-1324-00 ..... **$105**

Card Cage Extender – Order 067-1267-00 ..... **$895**

11801A Multi Channel Kit – Order 040-1267-01 ..... **$1,690**

**1 Please contact your local Tektronix representative for price and ordering information.*

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

GPIB IEEE-488 — The 11801A complies with IEEE Standard 488.1-1987, and with Tektronix Standard Codes and Formats.

SD-14/-20
SD-22/-24
SD-26/-30
SD-32/-42
SD-46/-51

Sampling Heads

CSA 803/11800 Series

High performance sampling heads provide high bandwidth sampling for a multitude of applications.

SD-14

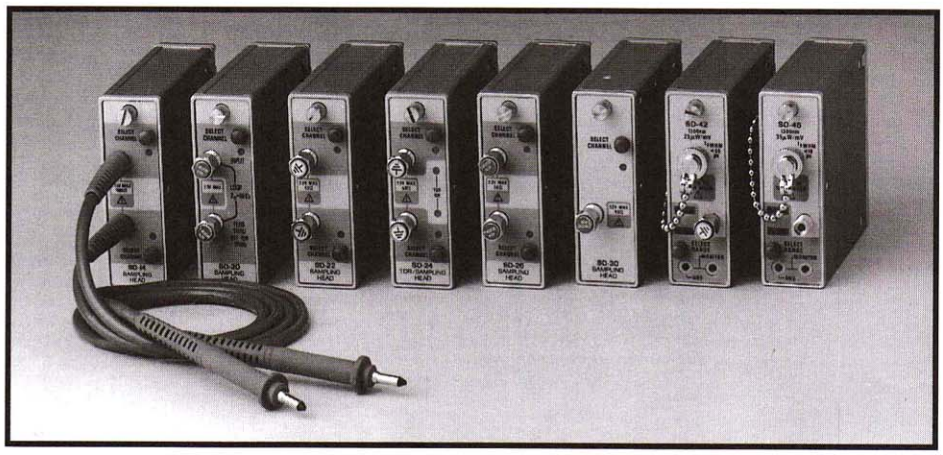
- 100 kΩ, 0.45 pF Typical
- 7 Vp-p Dynamic Range
- 3 GHz Bandwidth
- ECL, CMOS and GaAs Device Characterization

SD-20

- Loopthrough Sampling Head
- Unterminated
- General-Purpose TDR

SD-22

- 12.5 GHz Bandwidth
- Low-Noise
- Digital Data Communications
- Dual-Channel



SD-14 High Impedance Probe Sampler

The SD-14 is a dual channel, 3 GHz probe sampler designed for high impedance signal acquisition where a 50 Ω acquisition system is not the optimal solution. The SD-14 is ideal for high speed device characterization such as ECL, CMOS, ACL, and GaAs testing. The 100 kΩ input impedance and 0.45 pF capacitance results in very low loading of the device under test. The 7 volt dynamic range and ±3.5 V offset range, makes the SD-14 suitable for testing all digital logic families as well as most analog circuits.

The SD-14 consists of two samplers, each attached at the end of a 1.0 meter cable for easy circuit probing. The modular architecture of the CSA 803/11801A enables the use of extended samplers, bringing a new level of performance to sampling scopes. In conjunction with the 11801A and SM-11 multichannel unit, it is possible to configure up to 136 channels of high impedance, high-bandwidth acquisition with measurement accuracy approaching 140 ps.

SD-20 Loopthrough Sampling Head

The SD-20 is a single channel, 20 GHz loopthrough sampling head designed for low-loss testing in applications such as microwave systems research and development, digital device characterization, and high-speed digital communications circuit design. It provides an acquisition rise time of 17.5 ps, with typically 750 μV rms of noise (350 μV with smoothing) to ensure clean, undistorted signals.

The SD-20 is non-terminated, and keeps losses to a minimum by routing the signal of interest directly through the sampling head – without the need of a power divider. The SD-20 can also be used for customized TDR measurements of transmission lines and controlled impedance devices. An external signal generator may be used, instead of the SD-24 step generator, to tailor the TDR stimulus to fit a particular situation. For instance, slower slew rates or higher amplitude may be utilized, or you may perform half-sine or impulse testing.

In digital communications, the SD-20 is useful for viewing and triggering on the clock signal without the use of a power divider.

SD-22 Low-Noise Sampling Head

The SD-22 is a dual channel, 12.5 GHz sampling head specifically designed for low-noise measurement in digital communications and device characterization applications. It provides an acquisition rise time of 28 ps, and typically 450 μV rms of displayed noise. With smoothing, noise levels are 180 μV rms.

In order to precisely capture and display the switching characteristics of high-speed, communications circuits, to make accurate statistical measurements of signal noise and signal timing jitter, or to obtain stable timing measurements of fast digital ICs, the noise floor of the test equipment must be kept to a minimum. The SD-22 is the ideal instrument for these low-noise applications.

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

Sampling Heads
CSA 803/11800 Series

SD-24 TDR/Sampling Head

The SD-24 is a dual-channel TDR/Sampling Head. This sampling head has a rise time of 17.5 ps or less, with a typical 20 GHz equivalent bandwidth.

Each channel of the SD-24 is also capable of generating a fast rising step for use in Time Domain Reflectometry (TDR). In TDR mode, the acquisition portion of the sampling head monitors the incident step and any reflected energy. The reflected rise time of the TDR step is 35 ps or less. The polarity of each channel's TDR step can be selected independently of the other channel. This allows for differential or common-mode testing of two coupled lines, in addition to the independent testing of isolated lines. The SD-24 can be used to characterize crosstalk by using the TDR step to drive one line while monitoring a second with the other channel.

The "filter" function on the CSA 803/11800 can be used with TDR or crosstalk measurements to characterize a system at a slower risetime.

SD-26 Sampling Head

The SD-26 is a dual-channel, 20 GHz equivalent bandwidth sampling head. This sampling head has the same acquisition capability as the SD-24 TDR/Sampling Head but does not include the TDR step generators.

SD-30 Sampling Head

The SD-30 is a single-channel, 40 GHz bandwidth sampling head for use in high bandwidth applications. This sampling head was specifically designed for characterizing high-speed devices used in advanced data communications and microwave systems research. This performance is available for any new or existing CSA 803/11800 mainframe without having to upgrade to a new system, a result of the modular architecture of the CSA 803/11800 family. The SD-30 has a measured bandwidth of greater than 40 GHz and a calculated rise time of less than 8.8 ps.

SD-32 Sampling Head

The SD-32 is a single-channel, 50 GHz bandwidth sampling head. The SD-32 performance is available for any new or existing CSA 803/11800 mainframe. The SD-32 has measured bandwidth of greater than 50 GHz and calculated rise time less than 7.0 ps.

SD-42 Optical-to-Electrical Converter

The SD-42 Optical-to-Electrical Converter head can be used to analyze optical signals in the 1000 nm to 1700 nm wavelength range. The pulse response of the measurement system is less than 55 ps FWHM (Full-Width, Half-Maximum) which is equivalent to a calculated bandwidth of DC to 6.4 GHz. The electrical output on the front panel is coupled to the adjacent sampling head via the semi-rigid coaxial link provided.

The SD-42 is also equipped with an optical power meter for average power monitoring through a pair of voltage outputs on the front panel. Power from 5 nW to 5 mW can be measured.

For more information on this product, see the Opto-Electronics Instruments section, of this catalog.

SD-46 Optical-to-Electrical Converter

The SD-46 is an Optical-to-Electrical converter for use with the CSA 803/11800 Series Oscilloscopes equipped with an SD-22, SD-24, SD-26, SD-30, or SD-32 Sampling Head. The SD-46 is linear up to 25 mW peak input with a calibrated deflection factor from 50 µW/div to 5 mW/div at 1300 nm. This head has a 25 ps optical pulse response (maximum FWHM) with the SD-24 and SD-26.

For more information on this product, see the Opto-Electronics Instruments section, of this catalog.

SD-51 Trigger Head

The SD-51 Trigger-Countdown Head provides stable displays of signals from 1 to 20 GHz with less than 6 ps rms jitter.

The SD-51 is a free-running tunnel diode oscillator with a front-panel control to synchronize the oscillator to a subharmonic of the input signal and the output oscillator to a subharmonic of the input signal. The output from the SD-51 is coupled to the CSA 803/11800 Series trigger input connector. The output signal is a direct countdown of the input (and the input connector) and permits triggering by the sampling time base unit.

Continued on next page.

SD-24
- TDR/Sampling Head
- Dual-Channel, Differential TDR
- 20 GHz Bandwidth
- 35 ps Reflected Risetime
- Line Impedance & Crosstalk Characterization

SD-26
- 20 GHz Bandwidth
- Dual-Channel

SD-30
- 40 GHz Bandwidth
- Single-Channel
- High Bandwidth Communications and Microwave Applications

SD-32
- 50 GHz Bandwidth
- Single Channel

SD-42
- Optical-to-Electrical Converter
- DC to 6.4 GHz Optical Bandwidth
- 1000-1700 nm Wavelength Range

SD-46
- Optical-to-Electrical Converter
- 20 GHz Optical Bandwidth
- 1200 nm to 1650 nm Spectral Response

SD-51
- Trigger-Countdown Head
- 1 to 20 GHz Bandwidth
- Less than 6 ps rms Jitter

High performance sampling heads provide high bandwidth sampling for a multitude of applications.

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

SD-14/-20 SD-22/-24 SD-26/-30 SD-32/-42 SD-46/-51

Sampling Heads

CSA 803/11800 Series

SAMPLING HEAD CHARACTERISTICS

	Channels	Bandwidth	Risetime	Impedance	Noise	Applications (Typical)
SD-14	2	3 GHz	140 ps	100 kΩ/.45 pF	2 mV	ECL, CMOS, ACL GaAs Dev. Characterization
SD-20	1	20 GHz	17.5 ps	50 Ω unterm.	750 µV	Special TDR, communications
SD-22	2	12.5 GHz	28 ps	50 Ω	450 µV	Communications
SD-24	2	20 GHz	17.5 ps	50 Ω	750 µV	TDR/TDT Crosstalk
SD-26	2	20 GHz	17.5 ps	50 Ω	750 µV	Device Characterization
SD-30	1	40 GHz	8.8 ps	50 Ω	1.8 mV	High Bandwidth Communications & Microwave
SD-32	1	50 GHz	7.0 ps	50 Ω	1.8 mV	High Bandwidth Communications & Microwave
SD-42	1	6.4 GHz				Optical to Electrical
SD-46	1	20 GHz				Optical to Electrical

Characteristics

Acquisition System – SD-14, SD-22, SD-24, SD-26: dual channel; SD-20, SD-30: Single channel.

Rise Time – SD-14: 140 ps; SD-20, SD-24, SD-26: 17.5 ps; SD-22: 28 ps, all from 10% to 90%.

Bandwidth – 3 GHz for the SD-14; 20 GHz for the SD-20, SD-24, and SD-26; 12.5 GHz for the SD-22; 40 GHz for the SD-30.

Dynamic Range – 1 Vp-p within a ±1.6 V range for the SD-20, SD-22, SD-24, SD-30; 7 Vp-p within a ±3.5 V offset range for the SD-14.

Dot Transient Response – Accuracy after calibration at operating temperature is ±5% for signals up to 0.5 Vp-p. Adjustable to unity for signals up to 1.0 Vp-p.

Input impedance – SD-22, SD-24, SD-26: 50 Ω ±0.5 Ω. SD-14 is 100 kΩ and 0.45 pF. SD-20 is not terminated and not rated.

Displayed Noise –

With unity dot response:	Maximum	Typical
SD-20, SD-24, SD-26	1.2 mV	750 µV
SD-22	800 µV	450 µV
SD-14	8 mV	7 mV
SD-30	2.3 mV	1.8 mV
With smoothing:		
SD-20, SD-24, SD-26	550 µV	350 µV
SD-22	400 µV	180 µV
SD-30	1 mV	700 µV

Maximum Input Voltage – ±3V. SD-14: ±15 V. SD-30, SD-32: ±2V.

Isolation Between Channels – 1% p-p voltage transmission from the channel driven by the 067-1338-00, to the quiescent channel (see page 94).

Time Coincidence Between Channels – 10 ps accuracy; <0.2 ps/°C stability.

TDR SYSTEM (SD-24 ONLY)
Displayed Rise Time

Incident – 28 ps typical, 10% to 90%, at +250 mV or –250 mV output, elsewhere ±1%.

Reflected – 35 ps or less, 10% to 90%, at +250 mV or –250 mV output.

TDR Step Amplitude – Adjustable to ±250 mV (polarity of either step may be inverted).

Time Coincidence Between TDR steps – Adjustable to less than 1 ps.

Source Resistance – 50 ±0.5 Ω.

Aberrations (at ±250 mV amplitude) –
10 ns to 20 ps before step: ±3% or less.
< 300 ps after step: +10%, –5% or less.
300 ps to 5 ns after step: ±3% or less (not SD-14/SD-20). Elsewhere: ±1% or less.

ENVIRONMENTAL AND SAFETY CHARACTERISTICS

(11801A, CSA 803, SM-11, SD-Series Heads)

Temperature – Operating: 0°C to 50°C; Non-operating: –40°C to +75°C.

Altitude, Vibration, Shock, Bench Handling – Operating and Non-operating: meets MIL-T-28800C, Type III, Class 5.

Safety – Listed UL 1244 (not SD-14), CSA Bulletin 556B September 1973, Tektronix self-certification to comply with IEC 348 recommendation.

Electromagnetic Compatibility (not SD-14) – Meets the following requirements of MIL-STD-461C:
CE-03 Pt 4 Curve 1, CS-01 Pt 7, CS-02 Pt 4, CS-06 Pt 5, RE-02, Pt 7, RS-01 Pt 4, RS-02 Pt 5, RS-03, Pt 7 (limited to 1 GHz). Meets FCC Part 15, subpart J, Class A. For Germany: Meets VDE 0871/6.78 Class B. (Not all for SD-14).

Humidity – To 95% RH at up to 50°C.

Characteristics (SD-51)

Input Signal – Frequency range is 1 to 20 GHz. Stable synchronization on signals of at least 100 mVp-p, as measured separately into 50 Ω, 5 Vp-p max.

Input Characteristics – 50 Ω SMA (3 mm) connector. Open termination paralleled by 1 pF.

Trigger Output – Approximately 200 mV into 50 Ω. Jitter is 6 ps rms or less with signals from 5 to 20 GHz; 7 ps rms or less with signals from 1 to 5 GHz. Kickout at signal input is 180 mV peak; kickout occurs between successive samples.

Sampling Heads
CSA 803/11800 Series

SD-32/-42 | SD-14/-20
SD-46/-51 | SD-22/-24
SD-26/-30

ORDERING INFORMATION

SD-14
High Impedance Probe Sampler.....**$4,500**
Includes: Installation/User Manual (070-8286-00); Service Manual (070-8285-00); 4-post ECB mount ground socket; Edge tab ground socket; 10 ea. Wire-form ground, .050 spacing; 10 ea. Wire-form ground, .040 spacing; plastic accessories case.

SD-20
Loopthrough Sampling Head **$4,400**
Includes: Installation/User Reference (070-7531-00), Service Reference (070-7528-00), precision 3.5-mm termination (011-0155-00), 2 SMA short-circuit terminations (015-1020-00).

SD-24
Dual TDR/Sampling Head.....**$5,250**
Includes: Installation/User Reference (070-7052-00), Service Reference (070-7053-00), SMA short-circuit terminations (015-1020-00).

SD-26
Dual Sampling Head.....**$3,780**
Includes: Installation/User Reference (070-7226-01), Service Reference (070-7227-01), 2 SMA short-circuit terminations (015-1020-00).

SD-22
Low-Noise Sampling Head.....**$3,780**
Includes: Installation/User Reference (070-7226-01), Service Reference (070-7227-01), 2 SMA short-circuit terminations (015-1020-00).

SD-30
Sampling Head.....**$9,450**
Includes: Installation/User Manual (070-7904-00); Service Manual (070-7905-00); 1 SMA short circuit termination (015-1020-00).

SD-32
Sampling Head.....**$12,500**
Includes: Installation/User Reference (070-8268-00); Service Reference (070-8269-00); 1 SMA short-circuit termination (015-1020-00)

SD-42
Optical-to-Electrical Converter **$3,995**
See the Telecommunication Instruments section for complete information.

SD-46
Optical-to-Electrical Converter **$6,995**
See the Telecommunication Instruments section for complete information.

SD-51
Trigger Head **$3,500**
Includes: Installation/User Manual (070-7338-00), Service Reference (070-7339-00), 12 in. SMA male-to-male (174-1364-00).

WARRANTY-PLUS SERVICE OPTIONS
Opt. Q2 – Customer Site HW Service
SD-14.....**+$685**
SD-20.....**+$610**
SD-22.....**+$535**
SD-24.....**+$760**
SD-26.....**+$535**

PROBES
See Probe Section on page 423 for complete description.

50 Ω Divider Probes –
Single tip, 9 GHz, 0.15 pF/500 Ω, 1 m. Order P6150.....**$995**
2 tips; 10X, 100X. 10X: 3.5 GHz, 1 pF/500 Ω, 1.5 m;
100X: 3 GHz, 1 pF/5000 Ω ,1.5 m. Order P6156 Opt. 25.....**$325**
Requires SMA male-to-BNC female adapter when attached to SMA-type inputs. Order 015-0554-00. .....**$41**

Microwave Probes – See pages 468 to 471 for full details.

ADDITIONAL ACCESSORIES
SMA Accessory Kit – 2 each 2X and 5X attenuators; 2 each SMA Terminations, Male Short Circuit, Female Short Circuit, Male 50 Ω, Female 50 Ω, 2 each 50 Ω Signal Cables (2 ns), 2 each 500 ps Semi-Rigid Cable, 2 each Male-to-Male adapters, 2 each SMA Male-to-BNC Female, 2 each Female-to-Female, 1 each 50 Ω Power Divider, 1 each Combination Wrench (.312, 6 point).
Order 020-1693-00 .....**$2,195**

3.5 mm Accessory Kit – 1 each 50 Ω Reference Air Line, 1 each Male-to-Male Adapter, 1 each Female-to-Female Adapter, 1 each 26.5 GHz 50 Ω Terminator (Male), 1 each 26.5 GHz 50 Ω Terminator (Female), 1 each 26.5 GHz Short Circuit (Male), 1 each 26.5 GHz Short Circuit (Female), 2 each 50 Ω Terminators (6 dB 26.5 GHz, 2.9 mm), 2 each 50 Ω Terminators (20 dB 26.5 GHz, 2.9 mm), 1 each Power Divider (26.5 GHz, 2.9 mm), 2 each Signal blews (2 ns, Male-to-Male), 2 each Signal Cables (500 ps, Male-to-Male, 2.9 mm semi-rigid), 1 each Torque Wrench, 1 each Combination Wrench (0.312, 6 point), 1 each Combination Wrench (0.281, 6 point).Order 020-1692-00 .....**$7,400**

2X Attenuator – SMA Male-to-Female. Order 015-1001-00.....**$185**

5X Attenuator – SMA Male-to-Female. Order 015-1002-00.....**$175**

Power Divider – Order 015-1014-00.....**$300**

Blank Sampling Head – Order 200-3395-00 .....**$0.85**

ECL Terminator – Provides the bias and termination for ECL device outputs. At 10 GHz bandwidth and 1% precision attenuation, accurate AC and DC measurements are ensured. Attenuation: 10X ±1.0% @ DC, 20 dB ±3 dB, DC to 10 GHz Aberrations: ±3% max with 100 ps rise time.
Order 015-0558-00 .....**$910**

DC Block (Coupling Capacitor) – Order 015-1013-00.....**$315**

Slip-On Connector – Order 015-0553-00.....**$38**

Connector Savers – (SMA) Order 015-0549-00 .....**$185**
(APC) Order 015-0552-00.....**$245**

CABLES AND EXTENDERS
Sampling Head Extender Cables –
(1 m) Order 012-1220-00.....**$710**
(2 m) Order 012-1221-00.....**$735**

Acquisition Extender – Order 067-1324-00 .....**$105**

Acquisition System Extender –Order 067-1323-00 .....**$1,420**

Card Cage Extender – Order 067-1267-00 .....**$185**

Multi-Channel Kit – For 11801A. Order 040-1267-01.....**$1,650**

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

SM-11
DL-11
SIU 800

Multi Channel Unit Delay Line

Developed for use in applications such as TDR circuit board testing and cable testing.

SM-11

- Multi-Channel TDR and Simultaneous Acquisition
- Up to 136 Acquisition Channels when Connected to the 11801A Digital Sampling Oscilloscope

DL-11

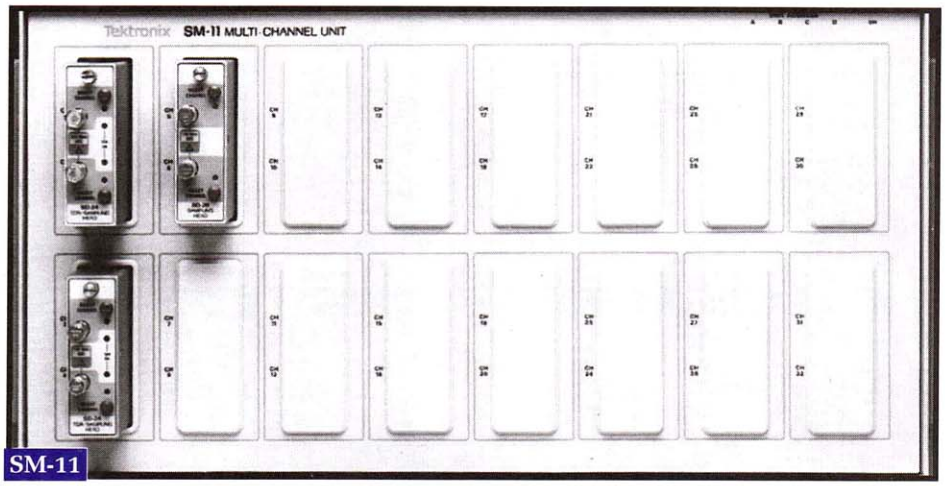
- 47.5 ns Compensated Dual Delay Line
- 5 GHz Bandwidth

CALIBRATION STEP GENERATOR

- 250 mV
- Verifies Specifications of SD-20, SD-22, SD-24, SD-26 Sampling Heads.

SIU 800

- <40 ps Reflected Risetime when used with SD-24
- <80 mp Reflection Coefficient



SM-11

The SM-11 Multi-Channel Unit can accept up to 16 SD-Series Sampling Heads.

SM-11 Multi-Channel Unit

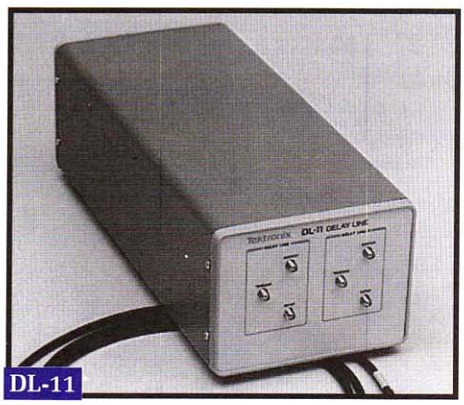
The SM-11 Multi-Channel Units expand the 11801A Digital Sampling Oscilloscope to 136 channels. Each SM-11 accepts up to 16 of the SD-Series Sampling Heads; an 11801A mainframe, with Option 1M added, is capable of driving up to four SM-11 Units. The entire system can then be driven through a single GPIB address.

The 11801A/SM-11 acquisition system is designed to acquire up to 68 channels in a single acquisition. Thus, in two acquisition cycles, all 136 channels can be acquired.

The hardware measurement capability of the 11800 system allows timing measurements to be taken in single acquisition cycle. This greatly increases the throughput of a large multi-channel system over that of a system where the signals must be multiplexed through a small number of acquisition channels and then processed in software to determine measurement results.

PHYSICAL CHARACTERISTICS

	Cabinet		Rackmount	
Dimensions	**mm**	**in.**	**mm**	**in.**
Width	448	17.6	483	19.0
Height	238	9.4	222	8.8
Depth	558	22	550	21.6
Weights	**kg**	**lb**	**kg**	**lb**
Net	20.0	44	20.9	46
Shipping	23.6	52	24.5	54



DL-11

DL-11 Delay Line

The DL-11 Delay Line provides approximately 47.5 ns of delay from the signal input to the signal output. The DL-11 contains two delay lines that when connected, allow you to view the triggering event through the 11801A or CSA 803. The DL-11 has approximately 5 GHz bandwidth and attenuates the signal by 50%.

A delay line can reduce horizontal jitter and provide more accurate measurements because it lets you take measurements on the first rising edge of the triggering event.

The DL-11 Delay Line contains two delay lines each with 47.5 ns delay. The DL-11 is used for showing the triggering event of a signal displayed on an 11801A or a CSA 803.

PHYSICAL CHARACTERISTICS

Dimensions	**mm**	**in.**
Width	159	6.3
Height	119	4.7
Depth	356	14.0
Weight	**kg**	**lb**
Net	2.2	10
Shipping	3.08	14

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

Static Isolation Unit
Calibration Step Generator

SM-11
DL-11
SIU 800

Calibration Step Generator

The Calibration Step Generator is a very fast rise time, 250 mV step generator that verifies specifications of the SD-20, SD-22, SD-24, and SD-26 sampling heads. It is supplied with a certificate and test report, stating the rise time of the step based on a measurement-controlled, internal, Tektronix acquisition standard, to a tolerance of 1.5 ps typically. This reported rise time will not exceed 19.5 ps.

The output connector is a precision 3.5 mm male that allows direct interface to the SD-Series head. The step generator is triggered directly from the Internal Clock Output on a CSA 803/11800 Series mainframe.

SIU 800 Static Isolation Unit

The SIU 800 protects the sampling bridge from damage due to static discharge from circuit boards and cables. The SIU 800 is intended for use in applications such as TDR circuit board testing and cable testing where large static charges can be stored. When used with the SD-24 TDR/Sampling Head, the SIU 800 provides a reflected risetime of less than 40 ps and a reflection coefficient of less than 80 mp.

The SIU 800 is installed between the DUT and sampling head and is controlled manually by a foot switch or under program control through a TTL-compatible input. When the foot switch is in the normal position (not pressed), the DUT is grounded through a 50 Ω termination resistor. This will discharge any static charge stored in the DUT. Pressing the foot switch connects the DUT to the sampling head input allowing a measurement to be made. Both channels are controlled simultaneously by the foot switch or TTL input.

PHYSICAL CHARACTERISTICS

Dimensions	mm	in.
Width	23.28	0.95
Height	71.05	2.9
Depth	91.39	3.8
Weight	**kg**	**lb**
Net	0.205	0.69
Shipping	0.441	2.0

ORDERING INFORMATION

SM-11
Multi-Channel Unit **$24,500**
Includes: Installation/User Manual (070-7048-00), Service Reference (070-7049-00), Power Cord, U.S., 120 V (161-0066-00).
Opt. 1R – Rackmount. ..... **+$250**

INTERNATIONAL POWER PLUG OPTION
Opt. A1 – Universal Euro: 220 V, 50 Hz ..... **NC**
Opt. A2 – United Kingdom: 240 V, 50 Hz ..... **NC**
Opt. A3 – Australian: 240 V, 50 Hz ..... **NC**
Opt. A4 – North American: 240 V, 60 Hz ..... **NC**
Opt. A5 – Switzerland: 220 V, 50 Hz ..... **NC**
See Customer Information Section for additional description.

WARRANTY-PLUS SERVICE OPTIONS
Opt. Q0 – Installation Service
SM11 ..... **+$95**
Opt. Q2 – Customer Site HW Service
SM11 ..... **+$750**
Service Section for additional information.

RECOMMENDED PROBES
See page 423 for complete description and full line of probes.

50 Ω Divider –
10X, DC to 9 GHz. Order P6150 ..... **$995**
10X, 3.5 GHz, 1 pF/500 Ω, 1.5m. Order P6156 ..... **$265**
Requires SMA male-to-BNC female adapter when attached to SMA-type inputs. Order 015-0554-00 ..... **$41**

ADDITIONAL ACCESSORIES
SMA Accessory Kit – 2 each 2X and 5X attenuators; 2 each SMA Terminations, Male Short Circuit, Female Short Circuit, Male 50 Ω, Female 50 Ω, 2 each 50 Ω Signal Cables (2 ns), 2 each 500 ps Semi-Rigid Cable, 2 each Male-to-Male adapters, 2 each SMA Male-to-BNC Female, 2 each Female-to-Female, 1 each 50 Ω Power Divider, 1 each Combination Wrench (.312, 6 point). Order 020-1693-00 ..... **$2,195**
3.5 mm Accessory Kit – 1 each 50 Ω Reference Air Line, 1 each Male-to-Male Adapter, 1 each Female-to-Female Adapter, 1 each 26.5 GHz 50 Ω Terminator (Male), 1 each 26.5 GHz 50 Ω Terminator (Female), 1 each 26.5 GHz Short Circuit (Male), 1 each 26.5 GHz Short Circuit (Female), 2 each 50 Ω Terminators (6 dB 26.5 GHz, 2.9 mm), 2 each 50 Ω Terminators (20 dB 26.5 GHz, 2.9 mm), 1 each Power Divider (26.5 GHz, 2.9 mm), 2 each Signal blews (2 ns, Male-to-Male), 2 each Signal Cables (500 ps, Male-to-Male, 2.9 mm semi-rigid), 1 each Torque Wrench, 1 each Combination Wrench (0.312, 6 point), 1 each Combination Wrench (0.281, 6 point). Order 020-1692-00 ..... **$7,400**
2X Attenuator – SMA Male-to-Female. Order 015-1001-00 ..... **$185**
5X Attenuator – SMA Male-to-Female. Order 015-1002-00 ..... **$175**
Power Divider – Order 015-1014-00 ..... **$300**
Blank Sampling Head – Order 200-3395-00 ..... **$0.85**
ECL Terminator – Provides the bias and termination for ECL device outputs. At 10 GHz bandwidth and 1% precision attenuation, accurate AC and DC measurements are ensured.
Attenuation: 10X ±1.0% @ DC, 20 dB ±3 dB, DC to 10 GHz
Aberrations: ±3% max with 100 ps rise time
Order 015-0558-00 ..... **$910**
DC Block (Coupling Capacitor) – Order 015-1013-00 ..... **$315**
Slip-On Connector – Order 015-0553-00 ..... **$38**
Connector Savers – (SMA) Order 015-0549-00 ..... **$185**
(APC) Order 015-0552-00 ..... **$245**

CABLES AND EXTENDERS
Sampling Head Extender Cables
(1 m) Order 012-1220-00 ..... **$710**
(2 m) Order 012-1221-00 ..... **$735**
Acquisition Extender – Order 067-1324-00 ..... **$105**
Acquisition System Extender – Order 067-1323-00 ..... **$1,420**
Card Cage Extender – Order 067-1267-00 ..... **$895**
Multi-Channel Kit – For 11801A. Order 040-1267-01 ..... **$1,650**

DL-11
Delay Line **$4,200**
Includes: Installation/User Manual (070-7050-00), Instruction sheet (070-7051-00), 20 in. coaxial cable, RF 50 Ω (174-1427-00), 60 in. coaxial cable, RF 50 Ω (174-1428-00).

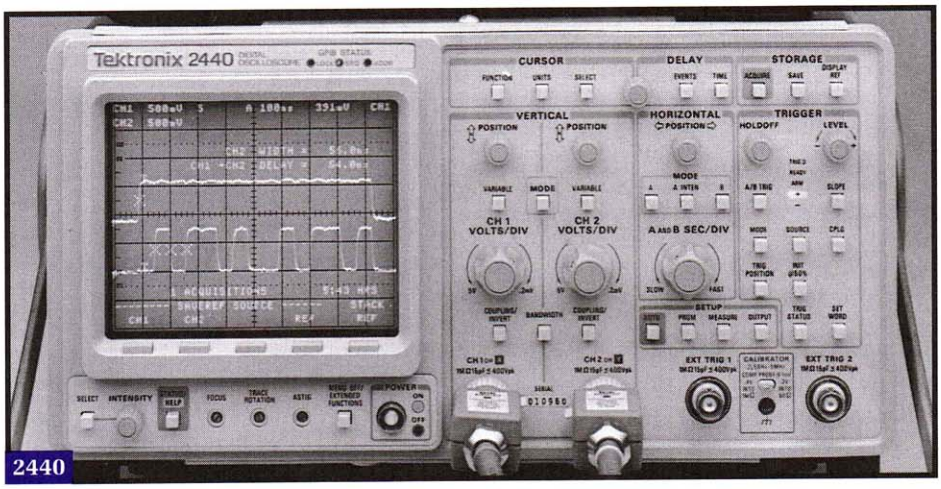
CALIBRATION STEP GENERATOR
U.S. – Order 067-1338-00 ..... **$5,490**
Includes: Instruction sheet; SMA female, short-circuit termination.
Universal Euro – 220 V, 50 Hz – Order 067-1338-01 ..... **$5,490**
United Kingdom – 240 V, 50 Hz – Order 067-1338-02 ..... **$5,490**
Australia – 240 V, 50 Hz – Order 067-1338-03 ..... **$5,490**
Switzerland – 240 V, 50 Hz – Order 067-1338-05 ..... **$5,490**
Japan – 100 V, 50-60 Hz – Order 067-1338-06 ..... **$5,490**

SIU 800
Static Isolation Unit **$1,650**
Includes: 12 VDC power supply, two SMA, Male-to-Female adapters, foot switch, two 50 Ω terminators, and an instruction/performance verification manual.

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

Digitizing Oscilloscopes
100 to 500 MS/s

2440
2430A



Compact Digitizing Oscilloscopes

The 2400 Series Digitizing Oscilloscopes combine high bandwidth and sampling rates with powerful automation features and waveform processing capabilities. Measurement accuracy is enhanced by 8-bit vertical resolution (11 bits with averaging), user-selectable Auto Setup and Measurement methods, selectable interpolation, and high-fidelity signal acquisition.

Advanced triggering is provided so you are sure to display a stable waveform, even in the presence of noise. The 2440 and 2430A capture glitches as narrow as 2 ns – a tremendous aid in troubleshooting. Fast update rate (due to Tektronix' proprietary Waveform Processor) insures near-real-time display response to changes in your signal and increases the probability that infrequent events will be captured and displayed.

QUICK MEASUREMENTS, SIMPLIFY SETUPS, AND AUTOMATE TESTING

Auto Setup – At the push of a button, the scope displays automatically scaled and triggered signals. The P6137 autoprobe supplied with the 2440 extends this capability to its probe-tip button.

Auto Measure – 21 waveform measurements are available for CRT readout and over the GPIB. Up to 4 may be selected for live (3 Hz) update, along with measurement aids and user-definable algorithms.

Auto Pass/Fail Testing – Use this special feature to compare incoming signals against reference waveforms. If the signal is out of limits, the scope time stamps it, alerts the operator or controller, or sends the offending waveform to a printer/plotter. References can be previously-acquired waveforms or templates transferred from a computer.

Continued on next page.

2400 SERIES

- 0.0015% Crystal-Controlled Time Base
- Simultaneous Two-Channel Sampling
- Extensive Triggering Capabilities
- Direct Printer/ Plotter Output
- Disk Storage Available with 2402A TekMate
- On-Screen "HELP" for All Functions
- MATE/CIIL Versions Available – 2440M and 2430M

The 2400 Series Digitizing Scopes offer a well-balanced combination of performance, automation, and convenience features.

2400 SERIES SELECTION GUIDE

	2440/2440M	2430A/2430M
Sampling Rate	500 MS/s	100 MS/s
Bandwidth (Repetitive)	300 MHz	150 MHz
Bandwidth (Single-Shot)	200 MHz	40 MHz
Vertical*1 Resolution	8 bits	8 bits
Glitch Capture	2 ns	2 ns
Time Bases	Main, Dly	Main, Dly
Auto Setup	View, Period Pulse, Edge	View, Period Pulse, Edge
Auto Measure	Live and Snapshot	Live and Snapshot
Auto Pass/Fail	Yes	Yes
Auto Sequencing	200 steps (typical)	200 steps (typical)
Auto Probe	Yes	No*2

**1 Digitizer resolution for single-shot acquisition. averaging of repetitive signals increases resolution to as much as 11 bits.*

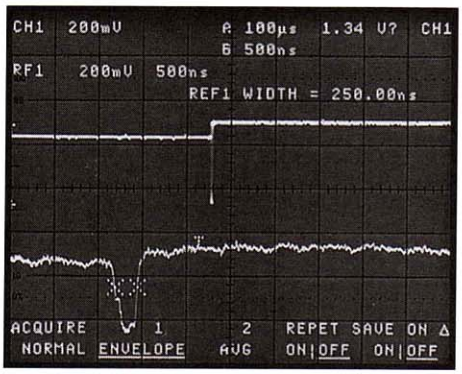
**2 Auto Probe facilities available with P6137 probe.*

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

GPIB IEEE-488 — The 2400 series complies with IEEE Standard 488.1-1987, and with Tektronix Standard Codes and Formats.

2440
2430A

Digitizing Oscilloscopes
100 to 500 MS/s



2 ns glitch capture allows you to see narrow events, for troublesome design problems.

Auto Sequence – Routines built from the front panel (without writing code!) can include steps to make measurements, compare live waveforms against references, and send data to a printer or plotter automatically. Eliminates or decreases the need for a computer/controller for many repetitive tests. Stores typically 50 to 200 setups and actions in up to 40 named sequences.

SAVE TIME AND REDUCE COST IN SYSTEMS OF ALL SIZES
In large systems, 2400 Series Digitizing Oscilloscopes cut controller time and bus traffic to increase throughput. Averaging, smoothing, measuring, and pass/fail testing can all be done by the scope upon a simple command by the controller.

STAND-ALONE OPERATION IN LOW-VOLUME OR SHORT-RUN TESTS
The 2402A TekMate™ Instrument Extension extends the capabilities of the 2440 and 2430A. During execution, TekMate displays instructions on the scope's screen, sets scope controls, makes measurements and pass/fail decisions, and stores over 300 waveforms.

TEKTRONIX SECURE MEMORY ERASE
2400 Series Digitizing Oscilloscopes can be instantly declassified for removal from secure areas. Invoking the TekSecure™ feature completely erases waveform, front-panel, and sequence memories, restarts the instrument with factory settings, then gives positive indication that erasure has been accomplished.

MATE/CIIL CAPABILITY
The 2440M and 2430M include Control Intermediate Interface Language (CIIL) capability. This is essential for operation in Modular Automatic Test Equipment (MATE) used in testing military avionics and weapons systems.

SOFTWARE
Powerful, off-the-shelf software packages that run on the IBM PC, XT, AT or compatibles.

Wavewriter software is designed specifically for the 2400 series. See the software section for complete information.

TEST DIGITAL CARRIERS
The 2410 Digital Interface Test System is a fully integrated hardware and software package. It quickly and accurately tests digital carriers to ANSI or CCITT specifications.

QUICKSTART OPERATOR'S TRAINING PACKAGE
- Complete with Videotape, Workbook, and Circuit Board
- Basic Training for First-Time Users
- Advanced Techniques for Experienced Operators
- Refresher for Occasional Users

Proceed at your own pace through sections designed for users of various experience levels. The workbook offers an introduction to digitizing scope measurements, intermediate and advanced exercises, and procedures for calibration and diagnostics.

The QuickStart videotape previews measurement exercises and explains key points of the Workbook. All necessary signals are available on the QuickStart Circuit Board.

QuickStart is a complete and portable training package. It can serve several users for thorough self-study or as a quick, easy reference. QuickStart can be ordered as an option to your new scope or separately.

Characteristics

Characteristics are common to the 2440, (2440M) and 2430A (2430M) except where indicated.

VERTICAL SYSTEM
Channels – two, simultaneous acquisition.

Bandwidth Limit – selectable 20 MHz or 100 MHz (2440), 20 MHz or 50 MHz (2430A).

Vertical Sensitivity – 2 mV/div (200 µV/div with expansion or averaging) to 5 V/div, continuously variable between ranges.

Vertical Accuracy – ±2% + 1 digitizing level (25 digitizing levels per CRT division), includes amplifier accuracies and A/D converter resolution.

AC-Coupled Lower – (–3 dB Point) 10 Hz or less.

Frequency Response – (–3 dB Repetitive Bandwidth)

Instrument	–15°C to +30°C	+30°C to +55°C
2440	300 MHz	reduce bandwidth by 2.5 MHz for each °C above +30°C
2430A	DC to 150 MHz	DC to 150 MHz

Measured with standard accessory probe or internal 50 Ω termination.

Input Coupling and Max Voltage – (1 MΩ) AC, DC, GND; Max input voltage: 400 V (DC + peak AC) (50 Ω); Max input voltage: 5 V rms.

Input R and C – 1 MΩ and 15 pF or 50 Ω (nominal).

Vertical Position Range – ±10 div (nominal).

HORIZONTAL SYSTEM
Display Modes – A, A INTENsified, B.

Time Base Accuracy – 0.0015%.

Maximum Time Base Resolution – 40 ps (2440), 100 ps (2430A).

A and B (Delayed) Sweep Time Base Range – 2 ns/div to 5 s/div (2440), 5 ns/div to 5 s/div (2430A).

External Clock Frequency – 1 MHz to 100 MHz.

Delay by Events – Delays A or B sweep by user-selected number of B trigger events after the normal A trigger occurs, max number of events: 65,536.

Digitizing Oscilloscopes
100 to 500 MS/s

2440
2430A

ACQUISITION SYSTEM

Single-Shot Bandwidth – 200 MHz (2440), 40 MHz (2430A) using internal Modified (sine x)/x interpolator with REPET mode OFF.

Maximum Sample Rate – 500 MS/s (2440) and 100 MS/s (2430A) on both channels simultaneously.

Update Rate – 30 Hz typical (100 Hz max with 50 kHz trigger, one channel selected, 100 µs/div).

Vertical Resolution – 8 bits or 0.39% (256 levels over 10.24 vertical divisions), 11 bits or 0.049% (2048 levels) with 64 or more averages.

Record Length – 1024 points per channel (all modes).

Acquisition Modes – Normal (real-time sampling), Repetitive (repetitive sampling), Envelope (displays min and max waveform values over one or more sweeps), Average (effectively increases vertical resolution and sensitivity).

Glitch Capture – pulses 2 ns and wider are captured at >50% amplitude with >85% confidence (5 s/div to 5 ns/div, REPET mode OFF for 2430A; 5 s/div to 500 ns/div for 2440).

MEMORY

Retention Time – >3 years for calibration, setups, and sequences.

TRIGGERING

A Mode – Auto Level, Auto/Roll, Normal, and Single Sequence.

B Mode – Triggerable After Delay, Runs After Delay.

A and B Source – Vertical, CH 1, CH 2, Line (A only), Ext 1, Ext 2, A*B (A sweep only), Word (17-bit word recognizer probe optional accessory).

A and B Coupling – AC, DC, Noise Reject, HF Reject, LF Reject, (Video, A mode only with Opt. 05).

A and B Trigger Position – 1/8 to 7/8 of acquisition record, user selectable in 1/8-1/4-1/2-3/4-7/8 sequence. User selectable in 32-sample intervals (from 1/32 to 30/32) using GPIB.

Ext 1 and Ext 2 Inputs –
Resistance: 1 MΩ ±1%
Capacitance: 15 pF ±3 pF.
Maximum Input Voltage: 400 V (DC + peak AC), 800 Vp-p AC at 10 kHz or less.

Trigger Level Control Range –
CH 1 and CH 2 Source: ±18 div x V/div.
Ext 1 and Ext 2 Source Gain ÷ 1: ±0.9 V.
Ext 1 and Ext 2 Source Gain ÷ 5: ±4.5 V.

OTHER SIGNAL OUTPUTS

CH 2 Signal Out, A Trigger, Record Trigger, Word Recognizer Trigger

POWER REQUIREMENTS

Line Voltage Ranges – 115 V: 90 V to 132 VAC; 230 V: 180 V to 250 VAC.

Line Frequency – 48 Hz to 440 Hz.

Maximum Power Consumption – Typical: 160 W (250 VA) for standard instrument, Maximum: 200 W (300 VA) for fully-optioned instrument.

AUTOMATIC MEASUREMENTS

21 Parameters – frequency, period, width, risetime, falltime, prop delay, duty cycle, overshoot, undershoot, RMS, area, minimum, maximum, mid, peak-to-peak, mean, base, top, proximal, mesial, and distal.

Thresholds – settable in percentage or volts. Methods to determine 0%, 100% – Min/Max, Histogram, Cursors.

Windows – measurement windows defined by time cursors.

Indicators – extensive warning and error-flagging capabilities.

Cursors – Volts, Time, Volts at Time, 1/Time, Slope; GPIB Programmability.

Compatibility – full talk/listen modes, control of all front panel settings, transmit/receive waveform data.

Data Transfer Rate – 30-40 waveforms/s typical.

Debug Mode – permits user to monitor bus traffic.

ENVIRONMENTAL AND SAFETY

Environmental Requirements –

- Meets requirements of MIL-T-28800D for Type III, Class 3, Style C equipment.
- Meets humidity and temperature requirements defined in paragraphs 3.7.2.2, 3.7.2.3, and 3.7.2.4.

Electromagnetic Interference (EMI) –

- Meets MIL-T-28800D.
- Meets MIL-STD-461C, Part 4 (CE-03 and CS-02), Part 5 (CS-06) and Part 7 CS-01 (RE-02, and RS-03), limited to 1 GHz.
- Meets VDE 0871, Category B, Part 15 of FCC rules and regulations, Subpart J, Class A.

Electrostatic Discharge Susceptibility – Meets Tektronix Standard 062-2862-00.

Radiation – Meets Tektronix Standard 062-1860-00.

Ambient Temperature – Operating: –15°C to +55°C. Nonoperating: –62°C to +85°C.

Humidity – Operating and non-operating: stored at 95% relative humidity for five cycles (120 hours) at +30°C to +60°C with operational performance checks at +30°C and +55°C.

Altitude – Operating: to 4500 m (max operating temperature decreases above 1500 m). Non-operating: to 15,000 m.

Shock – 50 g's.

Transit Drop – Meets MIL-T-28800D, paragraph 4.5.5.4.2.

Bench Handling – Meets MIL-STR-810E, Method 516.4, Procedure VI (MIL-T-28800D, paragraph 4.5.5.4.3) with and without cabinet installed.

Safety – Certified by CSA (CSA 556B) and UL listed (UL 1244).

ENVIRONMENTAL SPECIFICATIONS FOR RACKMOUNTED OSCILLOSCOPES

Rackmounting changes temperature, vibration, and shock capabilities. The rackmounted scope meets or exceeds the requirements of MIL-T-28800D with respect to Type III, Class 5, Style C equipment, when installed as directed. It also meets or exceeds Tektronix Standard 062-2853-00, Class 5 requirements.

Ambient Temperature – Operating: –15°C to +55°C, measured at the instrument's air inlet. Fan exhaust should not exceed +65°C.

Vibration – Operating: same as standard instrument, except total displacement is 0.015 inch p-p (2.3 g's at 55 Hz).

Shock – Operating and non-operating: same as standard instrument, except shocks are 30 g's.

PHYSICAL CHARACTERISTICS

	Cabinet		Rackmount	
Dimensions	**mm**	**in.**	**mm**	**in.**
Width (with handle)	338	13.3	483	19.0
Height				
(with feet and pouch)	190	7.5		
(without feet and pouch)	160	6.3	178	7.0
Depth			419	16.5
(with front cover)	479	18.9		
(with handle extended)	563	22.2		
Weights	**kg**	**lb**	**kg**	**lb**
Net (with accessories and Pouch)	12.8	28.1		
(without accessories and Pouch)	10.9	23.9	4.0	8.8
Shipping	16.4	36.0	20.4	44.8

Continued on next page.

Digitizing Oscilloscopes
100 to 500 MS/s

ORDERING INFORMATION

2440
500 MS/s Digitizing Oscilloscope **$9,195**
Includes: two P6137 10X auto-probes (1.5 m) with accessories, fuse (159-0014-00), snap accessory pouch (016-0692-00), front cover (200-3199-01), power cord, Operator's Manual, User's Reference Guide, Programmers Reference Guide, GPIB Pocket Guide.

2430A
100 MS/s Digitizing Oscilloscope **$8,395**
Includes: same as 2440, except 2 P6133 Opt. 25 10X (1.3 m) probes.

2440M
500 MS/s MATE/CIIL Digitizing Oscilloscope **$19,500**
Includes: same as 2440, plus MATE/CIIL Operator's Manual (070-6828-00) and 2440 Service Manual (070-6603-00).

2430M
100 MS/s MATE/CIIL Digitizing Oscilloscope **$15,500**
Includes: same as 2430A, plus MATE/CIIL Operator's Manual (070-6042-01) and 2430A Service Manual (070-6330-01).

Opt. 03 – Word Recognizer Probe Pod (P6407) ..... **+$600**

Opt. 05 – Video Waveform Trigger System ..... **+$1,295**

Opt. 11 – Probe Power ..... **+$225**

Opt. 22 – Two Additional Matching Probes
2440 ..... **+$390**
2430A ..... **+$310**
2440M ..... **+$370**
2430M ..... **+$240**

Opt. 29 – 2402A TekMate ..... **+$3,195**
(Not available for 'M' Versions)

Opt. 46 – Commercial Version of ARMY OS-291/G ..... **+$85**
(National Stock Number 6625-01-258-0022)

Opt. 2C – FeedThrough Cable Kit ..... **+$225**
(Included with Opt. 1R for 'M' Versions)

Opt. 2F – QuickStart Training Package (U.S. power) ..... **+$205**
(2440/2430A/ only)

Opt. 3F – QuickStart Training Package (Euro power) ..... **+$205**
(2440/2430A/ only)

Opt. 1P – HC100 Color Plotter (U.S. power 110 V) ..... **+$1,180**
(Includes GPIB cable) (Not available for 'M' Versions)

Opt. 2P – HC100 Color Plotter (Euro power 220 V) ..... **+$1,180**
(Includes GPIB cable) (Not available for 'M' Versions)

Opt. 1R – Rackmount ..... **+$330**

Opt. 1T – Transit Case (telescoping handle, retractable wheels)
(2440/2430A only) ..... **+$465**

Opt. 4F – French HELP Text (2440/2430A only) ..... **NC**

Opt. 4G – German HELP Text (2440/2430A only) ..... **NC**

Opt. 4H – Italian HELP Text (2440/2430A only) ..... **NC**

Opt. 4S – Spanish HELP Text (2440/2430A only) ..... **NC**

Opt. B1 – Service Manual (Not required for 'M' Versions)
(2440/2430A) ..... **+$55**

INTERNATIONAL POWER PLUG OPTIONS
Opt. A1 – A5 – available. ..... **NC**
See General Customer Information Section for description.

WARRANTY PLUS SERVICE PLANS
Three years covering parts and labor, includes CRT, excludes probes. Coverage can be extended to five years through the optional Warranty-Plus service plans.

Opt. M2 – Repair Protection
2440 ..... **+$475**
2440M ..... **+$415**
2430A ..... **+$435**
2430M ..... **+$385**

Opt. M8 – Calibration Service
2440 ..... **+$320**
2440M ..... **+$495**
2430A ..... **+$290**
2430M ..... **+$495**

SOFTWARE
See Software Section for complete description.

PROBES See Page 423 for complete probe line.
Active – (2430A/2430M) 500 MHz, 2 pF/10 MΩ, 2 m.
Order P6202A **$995**
(2440/2440M) 900 MHz, 1.5 pF/100 kΩ, 6 ft.
Order P6201 ..... **$1,495**

Differential – 100 MHz, active differential, 6 ft.
Order P6046 ..... **$2,195**

High Voltage –
100X, 120 MHz, 1500 V, 2.5 pF/10 MΩ, 9 ft. Order P6009 ..... **$265**
1000X, 75 MHz, 20 kV, 3.0 pF/100 MΩ, 10 ft.
Order P6015A Opt. 1R **$950**

General Purpose –
1X, 15 MHz, 100 pF/1 MΩ, 2 m. Order P6101B **$60**
10X, (2430A/2430M) 150 MHz, 10.8 pF/10 MΩ, 1.5 m.
Order P6133 with Opt. 25 ..... **$185**
10X, (2440/2440M) 400 MHz, 10.8 pF/10 MΩ, 1.3 m.
Order P6137 ..... **$195**
1X – 10X Switchable, 1X: 6 MHz, 105 pF/1 MΩ, 6 ft.
10X: 200 MHz, 14 pF/1 MΩ, 6 ft. Order P6063B **$320**

50 Ω Divider – 50 Ω inputs. 10X, 100X tips.
10X: 3.5 GHz, 1 pF/500 Ω, 1.5 m; 100X: 3 GHz, 1 pF/5000 Ω, 1.5 m.
Order P6156 with Opt. 25 ..... **$325**

Logic – 20 MHz, 17 bit, Word Recognizer/Trigger.
Order P6407 ..... **$600**

Micro/Fixtured – See Page 423 for selection guide.

Spring Contact – See Page 423 for selection guide.

Digital Timing Demodulator – Order TVC501 ..... **$2,495**

Current – 935 Hz to120 MHz, 3A peak. Order P6022 ..... **$595**
120 Hz to 60 MHz, 7.5A peak. Order P6021 ..... **$545**
DC to 50 MHz System. Includes AM503A, A6302 20 A probe.
Order AM503S **$2,595**

Cart – Order K212 ..... **$395**

Camera – Order C9 with Opt. 20 and Opt. 01A **$710**

Plotter – Order HC100 with Opt. 01 ..... **$1,180**

MANUALS
Operator's Manual –
(2440/2440M) Order 070-6599-00 ..... **$65**
(2430A/2430M) Order 070-6286-02 ..... **$65**

Programmer's Reference –
(2440/2440M) Order 070-6601-00 ..... **$25**
(2430A/2430M) Order 070-6338-01 ..... **$27**

GPIB Pocket Guide –
(2440/2440M) Order 070-6602-00 ..... **$6.75**
(2430A/2430M) Order 070-6604-01 ..... **$6.75**

User's Reference Guide –
(2440/2440M) Order 070-6602-00 ..... **$6.75**
(2430A/2430M) Order 070-6339-02 ..... **$6.75**

Service Manual –
(2440/2440M) Order 070-6603-00 ..... **$140**
(2430A/2430M) Order 070-6330-01 ..... **$140**

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

GPIB IEEE-488 — The 2400 Series complies with IEEE Standard 488.1-1987, and with Tektronix Standard Codes and Formats.

Digital Storage + Analog Real Time Oscilloscopes

How To Choose The Right Portable Scope For Your Measurement Needs.

The Tektronix 2200 Series digital plus analog scopes span a performance range from 20 MHz to 100 MHz.

To choose the right scope, first characterize your signal and decide if you need full-featured advanced performance or economical standard performance. An advanced 100 MHz oscilloscope is the most popular choice for most service and repair needs. With the addition of digital display technology, you can capture and analyze more types of signals. Finally, select a product class that meets your productivity needs and offers features to improve your measurement confidence. These enhancements make it easy to get fast and accurate results. The best in class products represent the latest offerings in each performance level.

The oscilloscope reference section provides additional information to assist you in your selection process.

ANALOG PLUS DIGITAL OSCILLOSCOPES

Model	Bandwidth	Sample Rate	Record Length	Vertical Resolution	Channels	Computer Interfaces	Time Bases	Page
2232	100 MHz	100 MS/s	1K to 4K points	8 bits	2	GPIB & RS-232 Opt.	Dual	106
2221A	100 MHz	100 MS/s	1K to 4K points	8 bits	2	GPIB & RS-232 Opt.	Single	106
2212	60 MHz	20 MS/s	4K points	8 bits	2	GPIB & RS-232 Opt.	Single	102
2201	20 MHz	10 MS/s	2K points	8 bits	2	RS-232 hardcopy	Single	104

CONTENTS

2200 SERIES
2212 60 MHz 102
2201 20 MHz 104
2232 100 MHz 106
2221A 100 MHz 106
2200 Software 109, 278

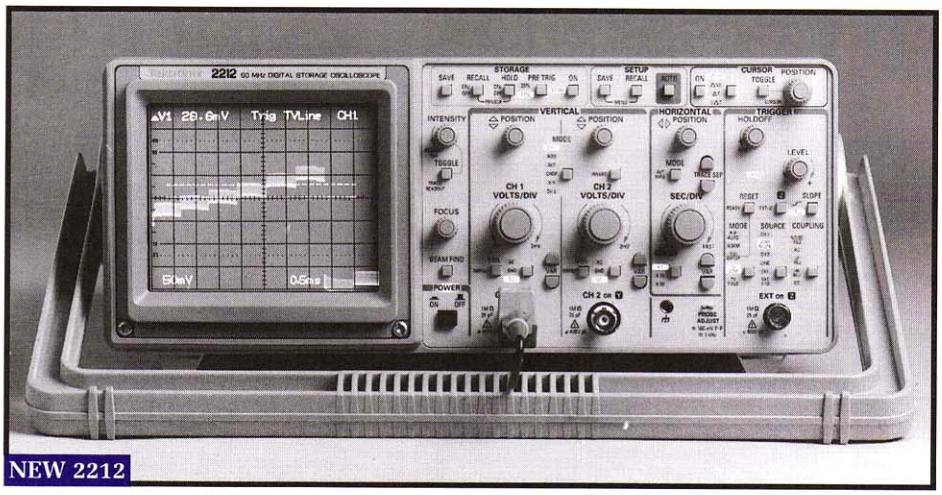
Digital + Analog Oscilloscopes

Programmable, 60 MHz, 20 MS/s

The new 2212 offers a dual channel analog plus digital storage oscilloscope, with crt readout, on-screen cursors, X-Y store and non-store operation, and a hardcopy parallel interface, at an affordable price.

2212

- 60 MHz Analog Bandwidth
- 20 MS/s per Channel Sample Rate
- Auto Setup
- Fully Programmable With Optional GPIB and/or RS-232 Options
- 4K Record Length per Channel
- 3-year Warranty Standard; 5-year Optional
- Cursor Measurements
- CRT Readout Including Trigger Level
- CE Conforms to applicable standards with the EMC directive 89/336/EEC
- UL Listed, CSA Certified, meets IEC-1010-1



Combines analog and digital capability with full programmability, push button hardcopy, and low price.

New 2212 Programmable Analog + Digital Oscilloscope

A familiar, convenient front panel layout and auto setup feature, enables fast, accurate measurements. With the push of a button, the scope switches between conventional analog and digital storage operation.

The front panel setup can be saved in a non-volatile memory. Also, two waveforms can be saved and recalled at any time when power is on.

Several on-screen readouts help you keep track of the settings for various functions, such as vertical and horizontal scale factors and trigger level.

On-screen cursors are provided to be helpful in making voltage, time and frequency measurements on the displayed waveform.

The horizontal alternate magnifier feature allows you to display the magnified and the unmagnified sweep alternately.

The parallel printer interface permits you to download acquired waveforms to a Centronics compatible printer/plotter for further analysis.

Optional to the 2212 oscilloscope are a GPIB and an RS-232C interface that allow full computer control. These optional features make the 2212 ideal for making automated measurements in a production or research environment that calls for repetitive data collection.

Typical applications include:

- Electronic product service
- Electro-mechanical research
- Production testing
- Process control
- Bio-physical application
- Audio applications

Characteristics

DIGITAL STORAGE SYSTEM

Sample Rate – 20 Ms/s max per channel.

Record Length – 4K per channel.

Pre/Post Trigger – 25% or 75%.

Acquisition Mode – Sample.

Save Reference Memory – One acquisition (4K/CH).

VERTICAL SYSTEM (2 Identical Channels)

Bandwidth (-3dB, and (+5°C to +35°C)) – 5 mV/div to 5 V/div: ≥60 MHz; 2 mV/div: ≥10 MHz and ≤15 MHz.

Resolution (Store) – -8 bits (25 levels per division).

Deflection Factor and Accuracy – 2 mV/div to 5 V/div, ±3%.

Vertical Operating Modes – CH 1, CH 2, CH 2 Invert, ADD, ALT, CHOP, X-Y.

Input Impedance – 1 MΩ in parallel with ±25 pF.

Maximum Input Voltage – 400 V (DC + peak AC). 800 Vp-p.

Channel Isolation – ≥100:1 at 10 MHz.

HORIZONTAL SYSTEM

Sweep Speeds – Non-store: 0.5 s/div to 50 ns/div. Store: 50 s/div to 20 µs/div.

Resolution (Store) – 400 points per div. Accuracy–X1: ±3%; X10: ±4%; X50: ±5% (all +15°C to +35°C).

Horizontal Modes – X1, X10, X50, X-Y (store and non-store), Alternate Magnifier.

Roll Mode – 0.1 s/div to 50 s/div in store mode.

TD

Call Direct – Product available within 24 hours, (through TekDirect only). Call 1-800-426-2200. Also available through an Authorized Tektronix Distributor (listed on page 540).

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

GPIB IEEE-488 — The 2200 Series complies with IEEE Standard 488.1-1987, and with Tektronix Standard Codes and Formats.

Digital + Analog Oscilloscopes

Programmable, 60 MHz, 20 MS/s

TRIGGER SYSTEM

Trigger Sensitivity – 0.35 div. from DC to 5 MHz, increasing to 1.2 div. at 60 MHz. External: 40 mV p-p from DC to 5 MHz, increasing to 150 mV at 60 MHz.

Trigger Modes – Peak-Peak AUTO, NORM, Single Sweep, TV LINE, TV FIELD.

Trigger Source – CH 1, VERT MODE, CH 2, LINE, EXT, EXT:10.

Trigger Coupling – NOISE REJ, AC, LF REJ (–3 dB at 30 KHZ and lower), HF REJ (–3 dB at 30 kHz and higher), DC.

Variable Holdoff – ≥8:1.

X-Y OPERATION

Deflection Factors – Same as vertical system.

Accuracy (Nonstorage) – X-Axis: ±5%; Y-Axis: Same as vertical system.

Accuracy (Storage) – Same as digital storage vertical system.

Bandwidth–X-Axis: ≥2 MHz; Y-Axis: Same as vertical system.

Phase Difference – ≤3° from DC to 150 kHz.

CURSOR FUNCTION AND ACCURACY

ΔVolts – ±3% of reading.

ΔTime (non-store) – ±4% of reading in X1; ±5% of reading in X10; ±6% of reading in X50 (all +15°C to +35°C).

ΔTime (store) – ±0.4% of reading in X1; ±0.5% of reading in X10; ±0.6% of reading in X50 (all + 15°C to +35°C).

External Clock – DC to 10 MHz.

HARDCOPY INTERFACE

Plots all 4K records, readout and graticule (selectable in the MENU).

Driver – HPGL, EPSON.

User test – Selectable in the MENU.

Connector Type – 25-pin D-type female connector.

CRT SYSTEM

Display – 8 x 10 cm Internal Graticule.

Controls – Display/Readout INTENSITY, TRACE/READOUT Switch, FOCUS, BEAM FIND.

Z-AXIS – 5 V causes noticeable modulation, useable to 5 MHz.

POWER REQUIREMENTS

Line Voltage Range – 95 VAC to 128 VAC, or 190 VAC to 250 VAC (depends on line voltage setting).

Line Frequency – 48 Hz to 440 Hz.

Max. Power Consumption – 85 Watts (95 VA).

ENVIRONMENTAL CHARACTERISTICS

Ambient Temperature – Operating: +0°C to +40°C. Non-operating – 55°C to +75°C. Relative Humidity – Max. 95%.

Altitude – Operating: To 4570 m. Non-operating – To 15240 m.

EMC – Meets council directive 89/336/EEC.

EMI – Meets requirements per EN50081-1, VDE 871-B, FCC part 18, EN60555-2.

EMS – Meets requirements per EN50082-1, IEC 801-2,3,4.

Safety – UL listed, CSA certified, meets requirements per IEC 1010-1.

PHYSICAL CHARACTERISTICS

Dimensions	mm	in.
Height	138	5.4
Width	380	15.0
Depth (without cover)	445	17.5
Weight	**kg**	**lbs**
Net	7.5	16.5

ORDERING INFORMATION

2212

DSO + ART Oscilloscope ..... TD **$2,495**

Includes: Two 10X Voltage Probes (P6103B), Power Cord, Fuse, User Manual (070-8438-00), Reference (070-8592-00), Flat Washer, Loop Clamp.

Opt. 3R – Rackmount Kit ..... **+$250**

Opt. 10 – GPIB Communication Interface (complies with IEEE 488.2 1987) w/Grabber 3 s/w ..... TD **+$300**

Opt. 12 – RS-232-C Serial Communication Interface (conforms to EIA Standard RS-232-C) w/Grabber 3 s/w.. TD **+$300**

Opt. 23 – Two P6129B 1X/10X Readout Passive Probes ..... **+$190**

INTERNATIONAL POWER PLUG OPTIONS

Opt. A1 – Universal Euro 220 V, 50 Hz ..... **NC**

Opt. A2 – United Kingdom 240 V, 50 Hz ..... **NC**

Opt. A3 – Australian 240 V, 50 Hz ..... **NC**

Opt. A4 – North American 240 V, 60 Hz ..... **NC**

Opt. A5 – Switzerland 220 V, 50 Hz ..... **NC**

WARRANTY-PLUS SERVICE OPTIONS

Opt. M2 – Repair Protection ..... **+$150**

Opt. M8 – Calibration Service ..... **+$150**

PROBES

See Page 423 for complete description.

Passive Voltage –

10/100 MHz, 1X/10X ruggedized, w/o readout. Order P6129B **$90**

100 MHz, 10X ruggedized, w/readout. Order P6109B **$70**

15 MHz, 1X ruggedized. Order P6101B **$60**

Current –

20 Amp max, DC to 50 MHz, w/A6302 current probe. Order AM503S **$2,595**

100 Amp max, DC to 15 MHz, w/A6303 current probe. Order AM503S Opt. 03 ..... **$3,240**

High Voltage –

1.5 kV 100X, 120 MHz w/readout. Order P6009 ..... **$265**

40 kV 1000X, 75 MHz w/readout. Order P6015A Opt. 1R **$950**

Digital Timing Demodulator – Order TVC501 ..... **$2,495**

CART – Order K212 ..... **$395**

CAMERA/PLOTTER

Low-Cost Camera – Order C-9 Opt. 20 ..... **$510**

Plotter – Order HC100 ..... **$1,075**

ADDITIONAL ACCESSORIES

Rackmount Kit – Order 016-1204-00 ..... **$250**

Service Manual – Order 070-8439–00 ..... **$105**

Programmer Manual – Order 070-8440–00 ..... **$75**

Front Panel Cover – Order 200-3397-00 ..... **$18.50**

Accessory Pouch – Order 016-0677-02 ..... **$75**

Front Cover and Pouch – Order 020-1514-00 ..... **$80**

Carrying Case – Order 016-0792–01 ..... **$380**

Cable – PC to Centronics, 25-Pin. Order 012-1214-00 ..... **$55**

Viewing Hoods –

Collapsible. Order 016-0592-00 ..... **$16.50**

Polarized. Order 016-0180-00 ..... **$315**

Binocular. Order 016-0566-00 ..... **$24**

TD

Call Direct – Product available within 24 hours, (through TekDirect only). Call 1-800-426-2200. Also available through an Authorized Tektronix Distributor (listed on page 540).

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

GPIB IEEE-488 — The 2200 Series complies with IEEE Standard 488.1-1987, and with Tektronix Standard Codes and Formats.

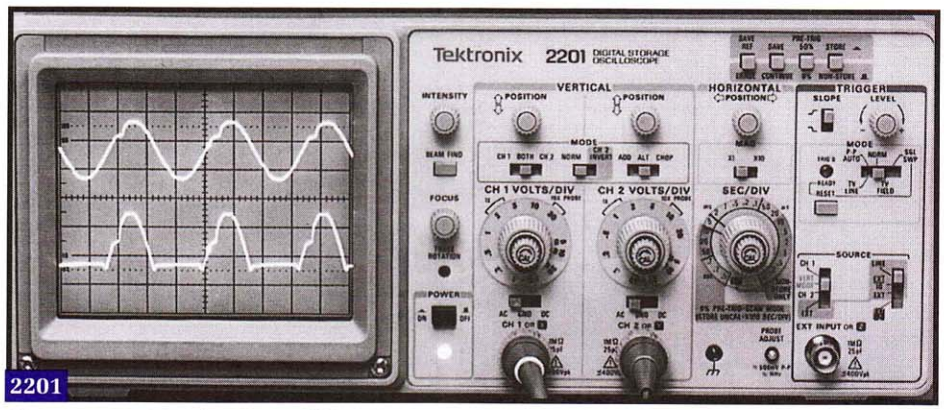
Digital + Analog Oscilloscope

20 MHz, 10 MS/s

Here's digital storage and analog familiarity plus documentation at an affordable price.

2201

- 20 MHz Analog Bandwidth
- 10 MS/s Per Channel Sampling
- 2K per Channel Record Length
- Hardcopy Interface Optional (RS-232-C)



The 2201 provides the power of digital storage, the familiarity of analog operation, and the affordability of Tektronix' lowest priced DSO.

2201 Digital + Analog Oscilloscope

Tektronix brings you familiar analog operation, plus CRT readout, on-screen cursors, and an RS-232-C hardcopy interface in a portable package. Now, with a 2201, you can have an inexpensive yet versatile oscilloscope with modern digital storage, without giving up the familiarity of analog operation.

The 2201 makes it easy to switch between conventional analog and digital storage operation. Just select storage or non-storage with the push of a button and the CRT switches between digital dot display and real-time mode.

PREMIUM SPECIFICATIONS

The 2201 provides 20 MHz analog bandwidth, two-channel sampling at 10 MS/s per channel, and a 2K record length per channel. Since the 2201 has dual digitizers, you don't sacrifice sampling speed or record length in two channel measurements.

A time base multiplier extends storage mode sweep speeds up to 50 s/div. Using the horizontal magnification, you can view delayed portions of the waveform similar to a dual time base oscilloscope. This allows analysis and documentation of slow or transient events found in physical measurement or electromechanical environments.

PUSH BUTTON DOCUMENTATION

The optional RS-232-C hardcopy output serial interface provides hardcopy documentation with HPGL and EPSON compatible plotters and printers, simply by pressing a button.

SOFTWARE

Tektronix GRABBER 2 software lets you transfer waveform data to an IBM PC/XT/AT (or compatible) for display, mass storage, or evaluation. This software creates an HPGL plot file which can be archived, converted to other formats or printed for documentation. Using a word processor which accepts HPGL files allows importing of stored waveforms to your documents. No complex communication protocols or cabling are required.

POWERFUL FEATURES FOR THE NOVICE OR EXPERT

In the digital storage mode, you can capture and display single-shot events and view low repetition rate signals without the usual flicker of an analog display. With digital pre-trigger you can view events that occurred before the trigger point, making it easy to identify trigger conditions.

These features make the 2201 the right instrument for a wide variety of applications. It is ideal for first-time users and seasoned operators.

Characteristics

DIGITAL STORAGE SYSTEM

Sample Rate – 10 MS/s max. per channel.

Resolution – Vertical: 8 bits (25 levels per division). Horizontal: 11 bits (200 points per division).

Record Length – 2K per channel.

Pre/Post Trigger – 0% or 50% trigger position selectable.

Acquisition Mode – Sample.

Save Reference Memory – One acquisition.

VERTICAL SYSTEM (2 Identical Channels)

Bandwidth (–3 dB) and Rise Time – 20 MHz and 17.5 ns.

Deflection Factor and Accuracy – 5 mV/div to 5 V/div, ±3%.

Vertical Operating Modes – CH 1, CH 2, CH 2 INVERT, ADD, ALT, CHOP (500 kHz).

CMRR – At least 10:1 at 10 MHz.

Input R and C – 1 MΩ, 25 pF.

Max Input Voltage – 400 V (DC + peak AC), 800 Vp-p.

Channel Isolation – 100:1 at 10 MHz.

TD

Call Direct – Product available within 24 hours, (through TekDirect only). Call 1-800-426-2200. Also available through an Authorized Tektronix Distributor (listed on page 540).

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

GPIB IEEE-488 — The 2200 Series complies with IEEE Standard 488.1-1987, and with Tektronix Standard Codes and Formats.

Digital + Analog Oscilloscope

20 MHz, 10 MS/s

HORIZONTAL SYSTEM

Sweep Speeds – 0.5 s/div to 0.05 µs/div, extended to 5 ns/div with X10 MAG. 0.5 s/div to 20 µs/div in store mode, extended to 50 s/div with X100 (store uncal).

Accuracy – X1: ±3%; X10: ±4%; X50: ±5% (all +15°C to + 35°C). X1: ±4%; X10: ±5%; X50: ±8% (all 0°C to + 40°C).

Horizontal Operating Modes – X-Y (non-store).

TRIGGER SYSTEM

Trigger Sensitivity – Internal: 0.35 div at 5 MHz, 1.0 div at 50 MHz. External: 40 mV at 5 MHz, 150 mV at 50 MHz.

Trigger Operating Modes – Peak-Peak AUTO (also TV LINE), NORM, TV FIELD, SGL SWP.

Trigger Source – VERT MODE, CH 1, CH 2, LINE, EXT, EXT/10.

Trigger Coupling – DC.

X-Y OPERATION

Deflection Factors – Same as vertical system.

Bandwidth – X-Axis: 2 MHz. Y-Axis: Same as vertical.

Phase Difference – ±3° from DC to 50 kHz.

ADVANCED FUNCTIONS

Hardcopy Interface (RS-232-C) – Plots all displayed records (X1 MAG), crt readout and graticule (selectable). Baud rate: 300 to 9600. Plotter Devices: HPGL, Epson FX-Series. Connector: 9-pin DTE (male).

Communication Software (Grabber 2) – Comes with the instrument and transfers waveform data from the 2201 to an IBM PC/XT/AT (or compatible). Uses the RS-232-C interface.

CRT SYSTEM

Display – 8 cm x 10 cm, 12.6 kV nominal voltage.

Controls – INTENSITY, TRACE ROTATION, BEAM FIND, FOCUS.

Z-Axis – 5 V causes modulation, usable to 5 MHz.

POWER REQUIREMENTS

Line Voltage Range – Low: 95 VAC to 128 VAC. High: 185 VAC to 250 VAC.

Line Frequency – 48 Hz to 440 Hz.

Maximum Power Consumption – 70 W (80 VA).

ENVIRONMENTAL/SAFETY CHARACTERISTICS

Instrument meets in part, the environmental requirements of MIL-T-28800D or C for Type III, Class 3, Style D or C equipment described as below.

Ambient Temperature – Operating: 0°C to +40°C. Non-operating: -55°C to +75°C.

Humidity – Percent: 95% 5 cycles, (120 hours) Reference: MIL-T-28800D, paragraph 4.5.5.1.2.2.

Altitude – Operating: To 4,500 m (15,000 ft), maximum operating temp decreases 1°C per 300 m above 1500 m. Non-operating: To 15,000 m (50,000 ft).

EMC – Meets Class B requirements per VDE 0871-B for radiated and conducted emissions and FCC requirements.

Vibration – Operating: 15 minutes along each of the 3 major axis. 10 Hz to 55 Hz in one minute cycles. Holds for 10 minutes at 55 Hz. Displ. (in p-p): 0.015.

Shock – Operating: 30 g, 1/2 sine, 11 ms duration, 3 shocks per axis along each major axis. Total of 18 shocks.

Safety – UL 1244 listed, CSA certification.

PHYSICAL CHARACTERISTICS

Dimensions	mm	in.
Width (with handles)	138	15.0
Height	380	5.4
Depth (without cover)	438	17.2
Weight	**kg**	**lbs**
	7.6	16.8

ORDERING INFORMATION

2201

20 MHz Digital Plus Analog Oscilloscope ..... TD **$1,895**

Includes: Two 10X Voltage Probes (P6103B), Operators Manual (070-7190-00), Users Ref. Guide (070-7232-00), 3 Year Warranty, Power Cord.

Opt. 12 – RS-232-C (2201) ..... TD **+$300**

Opt. 3R – Rackmount Kit ..... **+$250**

INTERNATIONAL POWER PLUG OPTIONS

Opt. A1 – Universal Euro 220 V, 50 Hz ..... **NC**

Opt. A2 – United Kingdom 240 V, 50 Hz ..... **NC**

Opt. A3 – Australian 240 V, 50 Hz ..... **NC**

Opt. A4 – North American 240 V, 60 Hz ..... **NC**

Opt. A5 – Switzerland 220 V, 50 Hz ..... **NC**

See General Customer Information Section for additional description.

WARRANTY-PLUS SERVICE OPTIONS

Opt. M2 – Repair Protection ..... **+$135**

Opt. M8 – Calibration Service ..... **+$135**

PROBES See Page 423 for complete description.

Passive Voltage –

60 MHz, 10X, ruggedized, without readout. Order P6103B **$50**

10 MHz/100 MHz, 1X/10X, switchable, without readout. Order P6119B **$75**

15 MHz, 1X, modular without readout. Order P6101B **$60**

Current – 20 Amp max, DC to 50 MHz, w/A6302 current probe. Order AM503S **$2,595**

100 Amp max, DC to 15 MHz, w/ A6303 current probe. Order AM503S Opt. 03 ..... **$3,240**

High Voltage – 1.5 kV 100X, 120 MHz with readout. Order P6009 ..... **$265**

40 kV 1000X, 75 MHz with readout. Order P6015A Opt. 1R **$950**

Specialty – 100 MHz, 1X/10X differential probe, FET. Order P6046 ..... **$2,195**

Logic Probe, 16 channel word recognizer/Trigger-TTL. Order P6408 ..... **$425**

Digital Timing Demodulator – Order TVC501 ..... **$2,495**

CART – Order K212 ..... **$395**

CAMERA

Low-Cost – Without graticule illum. Flash required on camera. Order C-9 Opt. 20 ..... **$510**

PLOTTER/PRINTER

RS-232-C – Order HC100 Opt. 03 ..... **$1,075**

ADDITIONAL ACCESSORIES

Carrying Strap – Order 346-0199-00 ..... **$22**

Transit Carrying Case – Order 016-0792-01 ..... **$380**

Front Panel Cover – Order 200-3397-00 ..... **$18.50**

Accessory Pouch – Order 016-0677-02 ..... **$75**

DC Power – Battery Pack. Order 1106 ..... **$3,495**

12 VDC to 110 VAC Inverter. Order 1107 ..... **$1,995**

Viewing Hoods – Collapsible. Order 016-0592-00 ..... **$16.50**

Binocular. Order 016-0566-00 ..... **$24**

Polarized. Order 016-0180-00 ..... **$315**

CRT Shields – Blue. Order 337-2775-00 ..... **$5.00**

Clear. Order 337-2775-01 ..... **$2.40**

Rackmount Kit – Order 016-0819-03 ..... **$275**

Service Manuals – Order 070-7189-00 ..... **$105**

TD

Call Direct – Product available within 24 hours, (through TekDirect only). Call 1-800-426-2200. Also available through an Authorized Tektronix Distributor (listed on page 540).

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

GPIB IEEE-488 — The 2200 Series complies with IEEE Standard 488.1-1987, and with Tektronix Standard Codes and Formats.

Digital + Analog Oscilloscopes

100 MHz, 100 MS/s

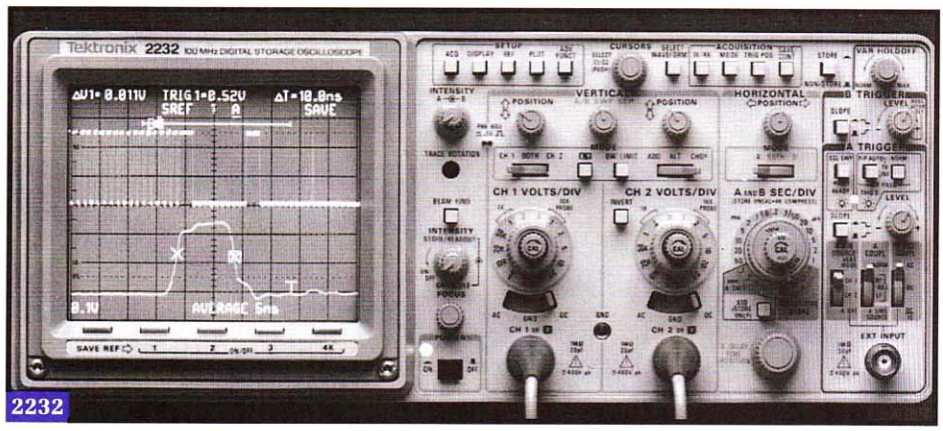
Waveform confidence and versatility unmatched at the price.

2221A

- 100 MHz Analog and Digital Storage Bandwidth
- 100 MS/s Per Channel Sampling Rate
- 10 ns Glitch Capture, Any Sweep Speed
- Selectable 1K or 4K Record Length
- 8-bit Vertical Resolution
- Time and Voltage Waveform Cursors
- Trigger-Level Readout
- GPIB or RS-232-C Communications Options

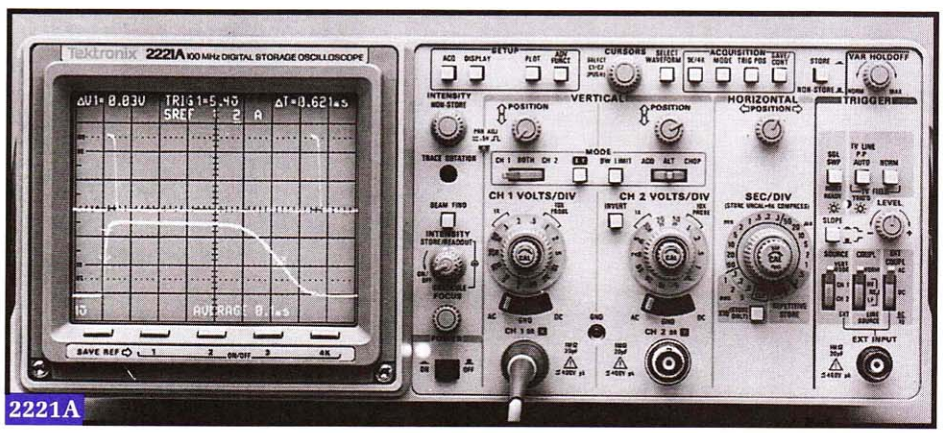
2232

- All The 2221A Features Above Plus:
- Dual Time Base
- 26K Battery-Backed Waveform Storage



2232

The 2232's peak detect mode captures glitches as narrow as 10 ns. Using the second time base and expansion feature, it's then easy to characterize the glitch.



2221A

The 2221A offers the same powerful digitizing capabilities in a single time base scope, making it an attractive lower cost alternative for many troubleshooting needs.

Unmatched Versatility

The 2232 and 2221A deliver high-end performance at the lowest price in their class. These 100 MHz oscilloscopes have advanced capabilities not found in comparable scopes. For single-shot and low repetition-rate signals, they offer simultaneous 100 MS/s sampling on each channel, 10 ns glitch capture, 1K and 4K record length, and battery-backed memory. When your signal is best viewed in real-time, a single push of a button makes each operate as familiar analog oscilloscope. This dual performance capability assures you the right solution is always at your fingertips.

The 2221A is an improved version of our popular 2221, offering the same digitizing performance as the 2232 in a single time base oscilloscope. The fast sample rate and long 4K record length provide plenty of signal capturing capability; its horizontal and vertical expansion of stopped waveforms facilitate the signal analysis.

HIGH-SPEED GLITCH CAPTURE

With innovative sampling technologies, these oscilloscopes are capable of catching random signal variations that are often missed with other digitizing oscilloscopes. In Peak Detect sampling mode, these scopes always sample at 100 MS/s, continuously observing your signal every 10 ns, regardless of sweep speed. This "glitch-finding" capability helps you quickly isolate problems such as power line spikes or false clock pulses that would otherwise be hidden between samples.

EXCELLENT WAVEFORM RESOLUTION

Both oscilloscopes acquire 1K or 4K records with 8-bit vertical resolution. They can display between 100 and 4096 points on-screen for precise analysis. Events as slow as 20 seconds (and slower with external clocking) or as fast as several nanoseconds can be captured and analyzed with confidence.

The 2232 adds a powerful dual time base system, allowing you to zoom in on any portion of your waveform and acquire a full record of information. A period of delay from the initial (A) trigger is set scrolling a "B-delay" intensified window to the point of interest. The 2232 can then immediately start acquiring samples at the new sweep speed, or await a trigger event to lock onto the point of interest.

TD

Call Direct – Product available within 24 hours, (through TekDirect only). Call 1-800-426-2200. Also available through an Authorized Tektronix Distributor (listed on page 540).

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

GPIB IEEE-488 — The 2200 Series complies with IEEE Standard 488.1-1987, and with Tektronix Standard Codes and Formats.

Digital + Analog Oscilloscopes

100 MHz, 100 MS/s

2232
2221A

WAVEFORM STORAGE AND ANALYSIS

Digital storage provides the opportunity to freeze events on-screen for analysis. But unlike many digital oscilloscopes, the 2232 and 2221A allow you to expand, compress, reposition, and measure a waveform after it has been captured. These capabilities apply to any stored waveform with the 2232, including non-volatile reference memories. The 2232 also adds an additional 26K of extended memory for waveform storage on-board. Thus, a reference library of up to 26 known-good waveform sets can be recalled at any time for performance verification. Or unknown signals can be captured and recalled later for analysis.

TIME-SAVING FEATURES

Bezel buttons, measurement cursors and on-screen readouts reduce analysis time and measurement error. Conveniently located bezel buttons let you easily select advanced menu functions. These functions include adjusting average weighting and sweep limits, point-selectable trigger position, and display modes.

Measurement cursors further simplify scope operation by calculating and displaying delta time and voltage. The cursors are tied to a selected waveform and can be positioned anywhere in a record (including off-screen over greater than 10 divisions) for detailed timing analysis. Scale factors automatically track the selected waveform.

INTERFACING ALTERNATIVES

The 2232 and 2221A offer a choice of interfaces: GPIB and RS-232-C. Both allow you to transmit and receive waveform data, query front-panel settings, control menu functions, and reset single-sweep trigger. In addition, you can connect the oscilloscope directly to a compatible printer or plotter for hardcopy output at the push of a button.

Tektronix makes interfacing with your personal computer easy. For example, Tektronix' "WaveSaver" package makes easy work of waveform transfer, documentation, and data archiving on your pc. For remote data transfer over commercial telephone lines, "TeleServicing" software adds modem control capabilities for a turn-key field service and remote-monitoring solution. See the T&M Software section of this catalog for more information on these and other software solutions.

Characteristics

Characteristics are common to the 2232 and 2221A except where noted.

DIGITAL STORAGE SYSTEM

Sample Rate – 100 MS/s per channel. Effective sample rates up to 2 GS/s in repetitive storage mode (0.5 µs/div and faster in single-channel mode, 0.2 µs/div and faster dual-channel).

Resolution – Vertical: 8 bits (25 levels per div.), up to 12 bits in average mode. Horizontal: 10 bits (100 points per div.), 9 bits per channel in dual channel mode.

Record Length – 4K or 1K selectable. 2K or 512 per channel in dual channel mode.

Pre/Post Trigger – 1/8, 1/2, or 7/8 trigger position selectable, selectable to any point in record via menu.

Acquisition Modes – Peak Detect (10 ns glitch capture at all available sweep speeds); Accumulated Peak Detect; Average (weight-selectable from 1/1 to 1/256); and Sample.

Save Reference Memory – One 4K or three 1K acquisitions battery-backed. 2232: adds 26K of extended memory (store up to 26 waveform sets). Battery-backed memory stores waveforms for up to 3 years.

VERTICAL SYSTEM (2 Identical Channels)

Bandwidth (–3 dB) and Rise Time – 100 MHz and 3.5 ns (0°C to +35°C); 80 MHz and 4.4 ns (2 mV/div or +35°C to +50°C).

Deflection Factor and Accuracy – 2 mV/div to 5 V/div ±2% (+15°C to +35°C); ±3% (0°C to +50°C).

Vertical Operating Modes – CH 1, CH 2, CH 2 INVERT, ADD, ALT, CHOP (500 kHz), and XY.

CMRR – At least 10:1 at 50 MHz.

Input R and C – 1 MΩ, 20 pF.

Max Input Voltage – 400 V (DC + peak AC), 800 Vp-p.

Channel Isolation – 100:1 at 50 MHz.

HORIZONTAL SYSTEM

Sweep Speeds – A sweep: 0.5 s/div to 0.05 µs/div, extended to 5 ns/div with X10 magnification. Store mode: 5 s/div to 0.05 µs/div (5 ns/div with X10 MAG). 2232: B sweep: 50 ms/div to 0.05 µs/div.

Accuracy – Nonstore Mode: X1: ±2%; X10: ±3% (+15°C to +35°C). X1: ±3%; X10: ±4% (0°C to +50°C). Store Mode: ±0.1% over full 10.24 divisions.

Horizontal Operating Modes – 2232: Nonstore Mode: A, ALT (A intensified by B and B), B. Store Mode: A, A intensified by B, B, 4K COMPRESS. 2221A: A; 4K COMPRESS in store mode.

Delay Jitter – 5000:1 (2232).

Delay Time Accuracy – ±1% (+15°C to +35°C).

TRIGGER SYSTEM

Trigger Sensitivity (A and B) – Internal: 0.35 div at 10 MHz, 1.5 div at 100 MHz. External: 40 mV at 10 MHz, 150 mV at 100 MHz (A trigger only).

Trigger Operating Modes – A-Mode: Peak-Peak AUTO (also for TV LINE), NORM, TV FIELD, SGL SWP. 2232 B-Mode: Runs-After-Delay, Triggered-After-Delay.

Trigger Source – A Trigger: VERT MODE, CH 1, CH 2, LINE, EXT. 2232 B Trigger: VERT MODE, CH 1, CH 2.

Trigger Coupling – With Internal Source: AC with P-P AUTO, TV LINE, or TV FIELD mode; DC with NORM or SGL SWP mode. With External Source: AC, DC, or DC/10. With Either Source: HF REJECT (attenuates above 40 kHz), LF REJECT (attenuates below 40 kHz).

Variable Holdoff – At least 10:1.

X-Y OPERATION

Deflection Factors – Same as vertical system.

Bandwidth – X-Axis: Nonstore mode 2.5 MHz; Store mode same as vertical system. Y-Axis: same as vertical system.

Phase Difference – ±3° from DC to 150 kHz.

ADVANCED FUNCTIONS

Cursor Function and Accuracy – ΔVolts: ±3% of reading. ΔTime: ±1 display interval (5 s/div to 1 µs/div); ±2 display intervals + 500 ps (0.5 µs/div to 0.05 µs/div).

X-Y Plotter Output – Plots all displayed waveforms, CRT readout, and graticule (selectable).

External Clock Input – DC to 1 kHz (roll mode), DC to 100 kHz (record mode).

CRT SYSTEM

Display – 8 cm x 10 cm, 14 kV nominal voltage.

Controls – A INTENSITY, B INTENSITY, TRACE ROTATION, BEAM FIND, FOCUS, STORAGE/READOUT INTENSITY, GRATICULE ILLUMINATION.

Z-Axis – 5 V causes modulation. Usable to 20 MHz.

POWER REQUIREMENTS

Line Voltage Range – 90 VAC to 250 VAC.

Line Frequency – 48 Hz to 440 Hz.

Max. Power Consumption – 85 W (150 VA).

ENVIRONMENTAL/SAFETY CHARACTERISTICS

Instrument meets in part, the environmental requirements of MIL-T-28800D or C for Type III, Class 3, Style D or C equipment described as below.

Ambient Temperature – Operating: 0°C to +50°C. Non-operating: -40°C to +71°C

Humidity – Percent: 95% 5 cycles, (120 hours) Reference: MIL-T-28800D, paragraph 4.5.5.1.2.2.

Continued on next page.

2232
2221A

Digital + Analog Oscilloscopes

100 MHz, 100 MS/s

Altitude – Operating: to 4,500 m (15,000 ft), maximum operating temp decreases 1°C per 300 m above 1500 m. Non-operating: to 15,000 m (50,000 ft).

EMC – Meets Class B requirements per VDE 0871-B for radiated and conducted emissions and FCC requirements.

Vibration – Operating: 15 minutes along each of the 3 major axis, 10 Hz to 55 Hz in one minute cycles. Holds for 10 minutes at 55 Hz. Displ. (in p-p): 0.015.

Shock – Operating: 30 g, 1/2 sine, 11 ms duration, 3 shocks per axis along each major axis. Total of 18 shocks.

Safety – UL 1244 listed, CSA certification.

INSTRUMENT OPTIONS

ANSI/IEEE-488.1 GPIB Interface (Option 10) – Function Subsets Implemented: SH1, AH1, T5, L3, SR1, RL2, PPO, DC1, DT0, C0, E2. Plotter Devices: HPGL (single-color), Epson FX-Series, HP ThinkJet. Data Transfer Rate: approximately 1 kilobyte/s.

EIA Std RS-232-C Interface (Option 12) – Baud Rate: 50 to 2400 for interactive use, up to 4800 for driving plotters. Plotter Devices: HPGL (single-color), Epson FX-Series, HP ThinkJet. Connectors: DCE (female), DTE (male).

QuickStart Training Package (Option 2F) – Includes QuickStart training manual and multiple signal source board with battery.

Rackmount Kit (Option 3R) – Provides rackmount kit for 5.25 in. rack height.

PHYSICAL CHARACTERISTICS

Dimensions	mm	in.
Width	360	14
Height	137	5.4
Depth	440	17.3
Weight	**kg**	**lbs**
Net	8.2	18.0

ORDERING INFORMATION

2232
100 MHz Dual Time Base, Digital + Analog Oscilloscope.. TD **$5,195**
Includes: Two 10X Voltage Probes (P6109B), Operator's Manual (070-7066-00), User's Ref. Guide (070-7068-00),Front Panel Cover (200-2520-00), Accessory Pouch (016-0677-02), 3 Year Warranty, Power Cord.

2221A
100 MHz Single Time Base, Digital + Analog Oscilloscope ..... TD **$3,995**
Includes: same as above except: Operator's Manual (070-8156-00), User's Ref. Guide (070-8158-00).

Opt. 10 – GPIB Interface ..... TD **+$300**
Opt. 12 – RS-232-C Interface (with pc/plotter cable) ..... TD **+$300**
Opt. 3R – Rackmount Kit ..... **+$250**

INTERNATIONAL POWER PLUG OPTIONS
Opt. A1 – Universal Euro 220 V, 50 Hz ..... **NC**
Opt. A2 – United Kingdom 240 V, 50 Hz ..... **NC**
Opt. A3 – Australian 240 V, 50 Hz ..... **NC**
Opt. A4 – North American 240 V, 60 Hz ..... **NC**
Opt. A5 – Switzerland 220 V, 50 Hz ..... **NC**
See General Customer Information Section for additional description.

WARRANTY-PLUS SERVICE OPTIONS
Opt. M2 – Repair Protection
2232 ..... **+$250**
2221A ..... **+$240**
Opt. M8 – Calibration Service
2232 ..... **+$250**
2221A ..... **+$240**

PROBES See Page 423 for complete description.
Passive Voltage –
10 MHz/100 MHz, 1X/10X, switchable, without readout.
Order P6129B **$95**
100 MHz, 10X, ruggedized, with readout. Order P6109B **$70**
15 MHz, 1X, modular without readout. Order P6101B **$60**
Current – 20 Amp max, DC to 50 MHz, w/A6302 current probe.
Order AM503S **$2,595**
100 Amp max, DC to 15 MHz, w/ A6303 current probe.
Order AM503S Opt. 03 ..... **$3,240**
High Voltage – 1.5 kV 100X, 120 MHz with readout.
Order P6009 ..... **$265**
40 kV 1000X, 75 MHz with readout. Order P6015A Opt. 1R **$950**
Specialty – 100 MHz, 1X/10X differential probe, FET.
Order P6046 ..... **$2,195**
Logic Probe, 16 channel word recognizer/Trigger-TTL.
Order P6408 ..... **$425**
Digital Timing Demodulator – Order TVC501 ..... **$2,495**
CART – Order K212 ..... **$395**

CAMERAS
Low-Cost – With graticule illum. No flash required on camera.
Order C-9 Opt. 20 ..... **$510**

PLOTTER/PRINTER
GPIB – Order HC100 Opt. 01 ..... **$1,180**

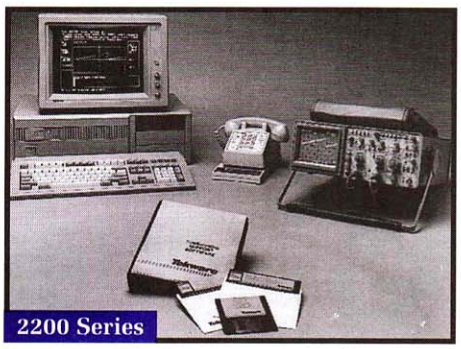
ADDITIONAL ACCESSORIES
Cables – GPIB Order 012-0991-00 ..... **$170**
RS-232 – 2232 to PC (25 pin). Order 012-0911-00 ..... **$100**
RS-232 2232 to plotter (25 pin). Order 012-1285-00 ..... **$44**
Carrying Strap – Order 346-0199-00 ..... **$22**
Transit Carrying Case – Order 016-0792-01 ..... **$380**
Front Panel Cover – Order 200-2520-00 ..... **$12.25**
Accessory Pouch – Order 016-0677-02 ..... **$75**
DC Power – Battery Pack. Order 1106 ..... **$3,495**
12 VDC to 110 VAC Inverter. Order 1107 ..... **$1,995**
Mounting Bracket for 1107 to 2232 – Order 016-0785-00 ..... **$70**
Viewing Hoods – Collapsible. Order 016-0592-00 ..... **$16.50**
Binocular. Order 016-0566-00 ..... **$24**
Polarized. Order 016-0180-00 ..... **$315**
CRT Shields – Blue. Order 337-2775-00 ..... **$5.00**
Clear. Order 337-2775-01 ..... **$2.40**
Service Manuals – 2232. Order 070-7067-00 ..... **$105**
2221A. Order 070-8157-00 ..... **$105**
GPIB Field Upgrade Kit – Order 2232F10 ..... **$300**
RS-232-C Upgrade Kit – Order 2232F12 ..... **$300**
Rackmount Kit – Order 016-0833-01 ..... **$275**
QuickStart Training Package – Order 020-1812-04 ..... **$199**

TD
Call Direct – Product available within 24 hours, (through TekDirect only). Call 1-800-426-2200. Also available through an Authorized Tektronix Distributor (listed on page 540).

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

GPIB IEEE-488 — The 2200 Series complies with IEEE Standard 488.1-1987, and with Tektronix Standard Codes and Formats.

Oscilloscope Interfacing & Software



For convenient documentation and analysis, off-the-shelf software packages are available to link many 2200 Series oscilloscopes to printers, plotters, and computers (such as Tektronix' TeleServicing solution).

Many of the 2200 Series instruments can be configured with a variety of interfaces to provide added functionality. These interfaces can provide a means to collect data into a computer, to control the oscilloscope with the computer, or to provide hardcopy output of the waveform data. In addition, through the use of specialized software, advanced functions (such as modem communications) are available.

GPIB INTERFACE

Several oscilloscopes can be configured with a GPIB interface. The new 2212 is Tektronix' lowest-cost, fully programmable portable oscilloscope. With its optional GPIB interface (IEEE-488.2-1987 Standard), you can control all scope controls remotely. Waveform and measurement data can be transmitted to a personal computer for storage and analysis. Test routines can be developed with the help of development software from Tektronix that can quickly automate many repetitive test applications.

The 2232 and 2221A Digital Storage Oscilloscopes can also be ordered with a GPIB interface (Opt. 10). With the interface installed, you can transmit and receive waveform data from the scope to personal computers and other peripherals. Most front-panel settings and menu states can be queried and many functions controlled via the interface, for example, single-sweep trigger reset. In addition, the instruments can provide hardcopy output when connected directly to a compatible printer or plotter. Devices supported include HPGL digital plotters, such as the Tektronix HC100, or the HP Thinkjet printer.

RS-232-C INTERFACE

All of the 2200-series DSO's can be ordered with an RS-232-C serial interface. The 2232 and 2221A can be ordered with an RS-232-C interface (Opt. 12) that provides all the functions described above for GPIB. The RS-232-C interface has both DCE and DTE connectors, selectable with baud rate, parity, and line termination using switches located on the oscilloscope side panel. Hardcopy output is also available, and includes support for Epson FX-Series printers with a serial interface.

The 2201 can be ordered with Option 12 to include the interface. On the 2201, the interface is designed as a talker-only interface. Hardcopy output is available using a number of devices, including HPGL serial plotters and Epson-compatible (FX Series) serial printers. A special software program included with the 2201, called Grabber 2, permits waveform transfer to a personal computer for long term storage or analysis.

CENTRONICS INTERFACE

The 2252 also comes equipped with a Centronics interface which provides hardcopy output for Epson FX-series printers. A push of the hardcopy button on the front panel causes all displayed wave-forms and measurements to be sent to the printer for documentation.

INTEGRATED SOFTWARE PACKAGES

To keep you focused on solving your problems, rather than software coding chores, Tektronix offers a variety of off-the-shelf software programs. Numerous packages are available for waveform acquisition, signal analysis, and instrument control. A partial listing is provided on this page as an example of solutions available.

For more information on utility and application software, see the Test and Measurement Software Section of this catalog.

SOME EXAMPLES OF SOFTWARE PACKAGES FROM TEKTRONIX:

- Printers and Plotters for Hardcopy Documentation
- Software for Instrument Control
- Software for Waveform Data Acquisition and Analysis

Some examples of software packages from Tektronix:

WaveSaver TD **(S41SAVE):** Waveform transfer, display, and storage with 2232-series oscilloscopes, utilizing easy-to-use pop-up menus and color EGA graphics.

TeleServicing TD **(S41TSS1):** Adds to WaveSaver the ability for remote instrument communication over modems. Includes integrated dialing directory and modem control software.

SPD (S3FG130): Signal Processing and Display software to simplify the acquisition, processing, and measurement of digitized waveforms.

EZ-Test PC (S45F030): A software productivity tool used to create and run automated test programs without the need for programming.

Tektronix offers the complete solution to your test and measurement needs, from hardware to software and accessories.

TD Call Direct – Product available within 24 hours, (through TekDirect only). Call 1-800-426-2200. Also available through an Authorized Tektronix Distributor (listed on page 540).

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

GPIB IEEE-488 The 2200 Series complies with IEEE Standard 488.1-1987, and with Tektronix Standard Codes and Formats.

INTERFACES AND PRINTER/PLOTTER DEVICES SUPPORTED

Scope	GPIB	RS-232	Centronics	HPGL	Epson FX	Thinkjet	Laserjet	Programmability
2252	Std	—	Std	—	Yes	—	—	Full
2232	Opt	Opt	—	Yes	Yes	Yes	—	Partial
2221A	Opt	Opt	—	Yes	Yes	Yes	—	Partial
2212	Opt	Opt	Std	Yes	Yes	—	—	Full
2201	—	Opt	—	Yes	Yes	—	—	—
222	—	Std	—	—	—	—	—	Full

222A
222PS
224

Handheld, Battery Operated Digital Storage Oscilloscopes

Capture your measurements in out of the way places with these battery operated, compact, industrial service digital scopes.

222A/222PS/224

- Floatable to ±850 V/channel, (±400 V/channel 222A)
- 60 MHz (10 MHz 222A, 222PS)
- Digital Storage
- 100 ns Glitch Capture
- 6 kV Peak Surge Rating (222PS, 224)
- Exclusive Motor Trigger (222PS)
- Exclusive Video Line Trigger (224)
- Auto Trigger
- Save Reference Memory
- 10 MS/s Dual Digitizers
- Fully Programmable via RS-232
- Rugged Construction
- Battery Operation
- DC Operation
- 4.4 lbs Total Weight
- UL Listed
- 3 Year Warranty
- Auto Setup/Save Setup/Recall
- Detachable X1/X10 Probes
- Ultra Portable

New 222A/222 PowerScout/New 224

The 222A, 224, and 222 PowerScout are the optimum scopes for industrial maintenance and field service. The 222 PowerScout and new 224 offers an unprecedented safety margin to users making measurements on industrial power systems.

Battery-Operated Handheld Oscilloscopes

The 220 family of scopes provides unsurpassed power in the world of HandHeld oscilloscopes. The instruments come standard with a 60 MHz bandwidth, (10 MHz 222A/222PS) 10 MS/s digitizing rate for each channel, RS-232 interface and full programmability in a size that goes anywhere. Battery operation eliminates the need for available power. The ability to charge and operate the scope from 12-28 VDC or 16-20 VAC makes the new 222A, 222PS, or new 224 truly portable scopes on the go.

UNMATCHED SAFETY

Because it is floatable to ±850 V per channel, the 224/222 PowerScout is designed to safely make measurements on industrial power systems. It is the first scope to be UL listed for measurements on line voltages to 600 VAC, and is specified to withstand peak surge voltages as high as 6 kV.

The channels are fully isolated from each other and the casing is double insulated ensuring ultimate operator safety. The 222A is capable of safely measuring to ±400 V per channel or 800 Vp-p.

AUTOSETUP/SAVE/RECALL

The 220 Series AutoSetup/Save/Recall features eliminate the need for unnecessary manipulation of the front panel. Just push the AutoSet button and the scope selects all the parameters for you. Save and recall those setups for repetitive situations at multiple sites and see the savings in time.

WAVEFORM STORAGE

After you've acquired your waveform using AutoSetup, save it in one of four 512 pt. reference memories. Recall it to compare with known good signals and make any adjustments to the source necessary to bring the equipment on line.

RS-232 AND THE 220 FAMILY

After saving your waveforms and setups, make a permanent record. Simply connect the 222A, 224, or 222 PowerScout to your PC and transfer them, using the optional CAT200 Software. Send them back to the scope when that same job is due again. In fact with CAT200 software, you can control the entire front panel from a remote location utilizing the RS-232 port, modems and a phone line.

SOPHISTICATED PROCESSING IN A SMALL PACKAGE

The 220 Family offers features normally found only on full size portable scopes: Acquisition modes such as Envelope (Peak Detect) and Averaging; Pre/Mid/Post triggering capabilities; AutoSetup, Save/Setup/Recall; Save reference memories; XY operation; and RS-232 programmability. These features make the 222 or 222PS the ultimate service tool. Both scopes come complete with a ballistic nylon carrying case that doubles as a neck strap for hands free operation.

RUGGED DESIGN

The 220 Family is packaged in impact-resistant plastic, capable of withstanding 50g's of force. (18 inch drop tested.) The Scopes can operate in temperatures as low as –10°C and still be accurate. The batteries allow for a minimum of three hours of remote operation.

INDUSTRY STANDARD WARRANTY

The 220 Family comes standard with a full three year warranty. Optional service warranties are also available to make the 222 or 222 PowerScout the worry-free instrument for the technician on the move, anywhere in the world.

Continued on next page.

TD

Call Direct – Product available within 24 hours, (through TekDirect only). Call 1-800-426-2200. Also available through an Authorized Tektronix Distributor (listed on page 540).

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

Handheld, Battery Operated Digital Storage Oscilloscopes

222A
222PS
224

Characteristics

DIGITAL STORAGE SYSTEM

Maximum Sample Rate – 10 MS/s on each channel.

Resolution – Vertical: 8 bits, 25 levels/div.

Record Length – 512 bytes.

Pre/Mid/Post-Trigger – 1/8, 1/2, 7/8 of waveform.

Acquisition Modes – Normal, Peak Detect, Accumulated Peak, Averaging.

Save Reference Memory – Four 512 byte acquisitions.

Front Panel Save/Recall – Save and recall up to four setups.

Motor Trigger (222PS only) – Trigger on first pulse in bursts separated by at least 2.25 ms modulated output of a motor controller.

VERTICAL SYSTEM

Bandwidth – Repetitive: 60 MHz. (10 MHz, 222A, 222PS) Single shot: 1 MHz.

Rise Time – 5.8 ns (35 ns – 222A, 222PS).

224/Deflection Factor – 222A: 5 mV/div to 50 V/div; 222PS/224: 50 mV/div to 500 V/div. (5 mV to 50 V/div. with P400.

Accuracy – 222A: ±3% (+10°C to +55°C); 224/222PS, 224: ±4%.

Operating Modes – CH 1, CH 2, Invert.

Input R & C – 222: 1 MΩ, 30 pF; 222PS: 10X probe, 10 MΩ, 4.5 pF.

Maximum Safe Input Voltage – 222A: 400 V (DC + peak AC), 800 Vp-p @ 1 kHz or less; 222PS with P850 probes: 600 VAC or 850 V (DC + peak AC) 6 kV peak surge.

Channel Isolation – >1000: 1 at 10 MHz.

HORIZONTAL SYSTEM

Sweep Speeds – 50 ns/div to 20 s/div (X10 mode increases max sweep speed to 5 ns/div).

Accuracy – X1: ±2%; X10: ±5%.

TRIGGER SYSTEM

Sensitivity – Internal: 0.5 div at 10 MHz. External: 250 mV at 10 MHz.

Trigger Sources – CH 1, CH 2 and External.

Video Field and Line (NTSC, PAL STD) – 0.5 V to 2 Vp-p range (224 only).

X-Y OPERATION

Accuracy – Same as Vertical System.

Useful Bandwidth – Same as Vertical System.

Skew between CH 1 & CH 2 – 5 ns.

CRT SYSTEM

Display – 6 x 10 divisions (0.5 cm).

RS-232 INTERFACE

Maximum Applied Voltage – 25 V (DC + peak AC).

Baud Rates – 300, 1200, 2400, 9600.

Levels – Compatible with RS-232C.

POWER REQUIREMENTS

Line Voltage Range – 12 to 28 VDC, 16 to 20 VAC.

Line Frequency – 47 Hz to 400 Hz.

Maximum Power Consumption – 16 VA.

Minimum Operating Time (batteries) – Three hours at maximum sample rate, no trigger, and auto-shutdown defeated.

Typical Operating Time (batteries) – Four to six hours.

Charging Time – Three hours.

Type – Sealed lead acid.

Discharge Protection – Scope automatically shuts down when charge drops to 7.32 V.

ENVIRONMENTAL

Ambient Temperature – Operating: –10°C to + 55°C; Nonoperating: –51°C to +75°C.

Altitude – Operating: 4500 m (15,000 ft.). Nonoperating: 15,000 m (50,000 ft.).

Humidity – 95%, five cycles (120 hours). Referenced to MIL-T-28800D, for Type 3, Class III instruments.

Vibration – Operating and Nonoperating: 15 minutes along each of the 3 major axes, 0.06 cm (0.025 in.) p-p displacement (4 g's at 55 Hz), 10 to 55 to 10 Hz in 1-minute cycles. Held for 10 minutes at 55 Hz in each 3 major axes.

Shock – Operating and Nonoperating: 50 g's 1/2 sine,11 ms duration each direction along each major axis. Total of 18 shocks.

Safety – UL, CSA.

Emissions – FCC A and VDE B.

Display – Update rate 30 Hz, Resolution 256 V x 512 H, Contrast 75:1, Brightness 30 Fl.

Viewing Angle – 160°

Pixel Writespeed – <1 ms.

Record length – 512 bytes.

PHYSICAL CHARACTERISTICS

Dimensions	mm	in.
Width	159	6.3
Height	86	3.4
Depth	252	9.9
Weight	**kg**	**lb**
Net, w/o accessories	2.0	4.4
Shipping	3.2	7.0

ORDERING INFORMATION

222A
Handheld DSO ..... TD **$2450**
Includes: Operator Manual, Quick Ref. Guide,RS-232 Guide, AC Adapter, Replaceable Probes, Pouch, Feet, Probe Acc. Kit.

222PS
Handheld DSO ..... TD **$2750**
Includes: Everything in 222A plus Industrial Leadset.

224
Handheld DSO ..... TD **$2750**
Includes: Everything in 222A.
Opt. 02 – Delete Adapter ..... **NC**

OPERATION TAPE
NTSC – Order 068-0344-04 ..... **$60**
PAL – Order 068-0344-06 ..... **$70**
SECAM – Order 068-0344-07 ..... **$70**

WARRANTY-PLUS SERVICE OPTIONS
Opt. M2 – Repair Protection
222A/222PS ..... **+$178**
224 ..... **+$171**
Opt. M8 – Calibration Service
222A/222PS ..... **+$144**
224 ..... **+$138**

INTERNATIONAL POWER PLUG OPTIONS
Opt. A1 – Univ Euro 220 V, 50 Hz. NC ..... **NC**
Opt. A2 – United Kingdom 220 V, 50 Hz. NC ..... **NC**

SOFTWARE
Virtual Instrument Software – Order CAT 200 ..... TD **$395**

RECOMMENDED ACCESSORIES
See Accessory Section on page 407 for complete line of accessories.

PROBES
Replaceable – 1X. Order P400 ..... **$60**
10X. Order P850 ..... **$100**
External Trigger – Order P6122 ..... **$95**

ADDITIONAL ACCESSORIES
External Battery Charger – Order BAT200 ..... TD **$200**
Battery/AC Adapter Pouch – Order 016-0993-00 ..... **$15.50**
Viewing Hood – Order 016-1021-00 ..... **$19.75**
EXT Trig to BNC Adapter – Order 103-0090-00 ..... **$13.50**
European Power Adapter – Order 120-1826-00 ..... **$30**
UK Power Adapter – Order 120-1827-00 ..... **$35**
Spare Battery – Order 146-0075-00 ..... **$80**
RS-232 Cable – Order 174-1453-00 ..... **$40**
Cigarette Lighter Adapter – Order 174-1734-00 ..... **$15.50**
Intelligent Printer Interface – Order WP200 ..... TD **$295**
Automotive Accessory Kit – Order CAR200 ..... TD **$475**
X10 BNC Adapter – Order 206-0445-00 ..... **$75**
Industrial Lead Set – Order 012-1392-00 ..... **$49**
BNC Probe Head – Order 206-0451-00 ..... *1

[1]Contact your local Tektronix representative for price information.

TD
Call Direct – Product available within 24 hours, (through TekDirect only). Call 1-800-426-2200. Also available through an Authorized Tektronix Distributor (listed on page 540).

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

Virtual Instrument Software

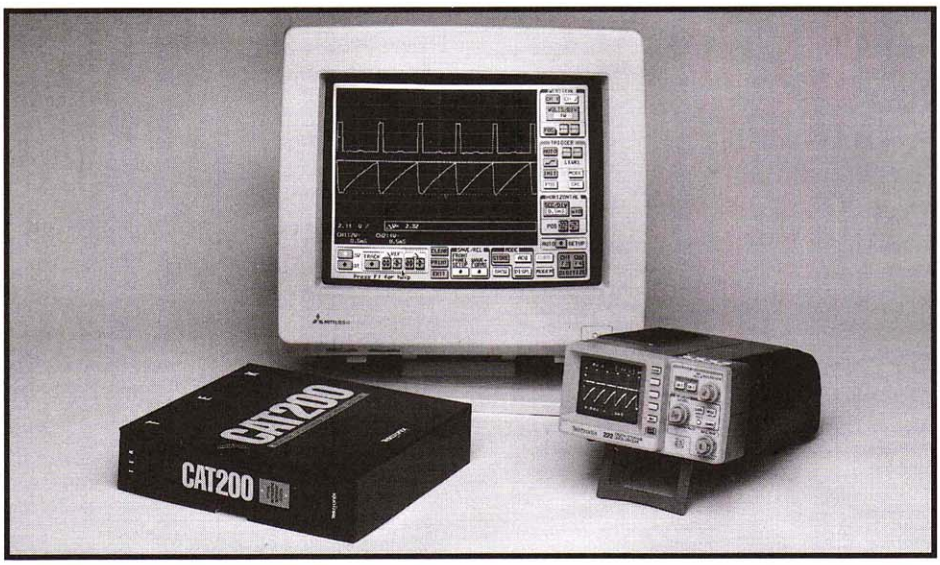
Control and collect waveform data from a remote location.

CAT200 VIRTUAL INSTRUMENT SOFTWARE FOR 222 SCOPE

- Enables Remote Control of 222/ 222PS Digital Oscilloscope Via RS-232
- Simplifies Data Collections and Storage
- Easy to Use Graphical Interface
- Works with All Hayes-Compatible Modems
- No Programming Required

TYPICAL APPLICATIONS

- Field Service
- Plant Maintenance
- Telecommunications
- Education



CAT200 Virtual Instrument Software for 222 Scope

CAT200 Virtual Instrument Software recreates the front panel of a Tektronix 222A, 222PS, or 224 digital storage oscilloscope on a IBM PC and PS/2 compatible computer monitor. The front panel is controlled using either the keyboard or a mouse. It has intuitive buttons and controls so the learning curve is short. When connected to a remote 220 Family Oscilloscope, the CAT200 package lets you control and collect waveform data from the scope to your computer.

Once in the computer, CAT200 automates voltage, time and frequency measurements with delta cursors. It simplifies documentation by providing hardcopy support. There is virtually unlimited waveform storage capacity where the data is stored in ASCII format or in a format compatible with the 222 driver for LabWindows.®

SYSTEM REQUIREMENTS

Requires IBM PC XT/AT or PS/2 compatible computer with at least 640 kbytes of memory, 1 floppy disk, EGA/VGA graphics adapter, MS-DOS 3.3 or above.

Hayes-compatible modem and/or Microsoft compatible mouse can be used for full utilization of the software features.

TD

Call Direct – Product available within 24 hours, (through TekDirect only). Call 1-800-426-2200. Also available through an Authorized Tektronix Distributor (listed on page 540).

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

ORDERING INFORMATION

CAT200
Includes: Users Manual, two 5.25 in. disks and one 3.5 in. disk..... TD **$395**

Analog Oscilloscopes

TAS 400 Series

The Tektronix TAS 400 Series Portable Analog Oscilloscopes are built on a new low cost platform. Modeled after the successful TDS Series, the TAS user interface simplifies scope operation. This new plateform design significantly reduces parts count and provides a three times improvement in reliability over previous analog scopes.

2200 Series

The Tektronix 2200 Series Portable Analog Oscilloscopes offer a broad choice of performance, ranging from the basic 20 MHz 2205 to the feature packed, fully programmable 100 MHz 2252.

2400 Series

The Tektronix 2400 Series Portable Analog Oscilloscopes represent the most widely used and accepted line in the industry. The 2467B "BrightEye" offers unsurpassed writing rate for the ultimate in fast event capture. The 2465B sets the standard against which other general-purpose portable scopes are measured.

All 2400 Series Oscilloscopes offer convenient and easy automatic setup and measurements, a broad range of functionality, and the depth of performance that set the standards for high-performance portable scopes.

ANALOG OSCILLOSCOPES

Model	Bandwidth	Channels	Time Base	Cursors	Auto Setup	Computer Interfaces	Pages
TAS 400	60 to 100 MHz	2	dual	yes	yes	no	114
2252	20 to 100 MHz	2+2	dual	SMART	yes	GPIB,	124
2247A				SMART	yes	Centronics	
2245A				SMART	yes	on 2252 only	
2205		2	single	no	no	no	128
2400B	200 to 400 MHz	2+2 aux.	dual	yes	yes	GPIB Opt.	118

CONTENTS

TAS Series Oscilloscopes
General Information....114
TAS 465 100 MHz....114
TAS 455 60 MHz....114
2400 Series Oscilloscopes
General Information....118
2467B 400 MHz, High Writing Speed....118
2467BHD 400 MHz HDTV Oscilloscope..118
2465B 400 MHz....118
2445B 200 MHz....118
2200 Series Oscilloscopes
2252 100 MHz, Dual Time Base....123
2247A 100 MHz, Dual Time Base....123
2245 A 100 MHz, Dual Time Base....123
2205 20 MHz....128

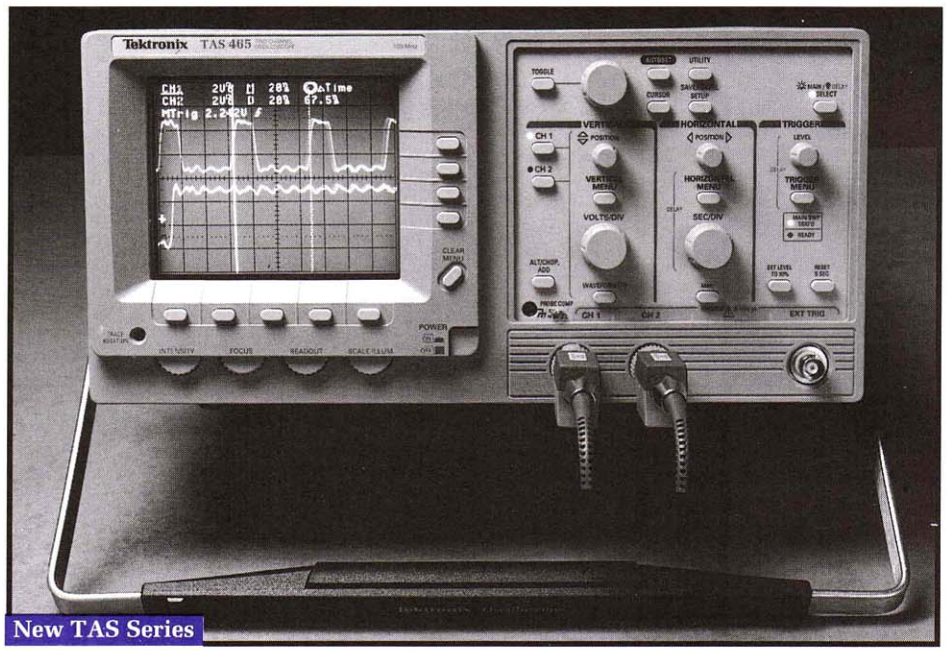
TAS 455
TAS 465

Analog Oscilloscopes
60 MHz to 100 MHz

New level of power and reliability to general purpose scopes.

TAS 455
TAS 465

- Bandwidths of 60 MHz and 100 MHz
- Two input channels
- Auto Setup
- Store/Recall of four setups
- Video triggering
- Delayed Sweep
- Measurement Cursors
- Trigger Level Indicator
- Ground Reference Indicator



New TAS Series

TAS 455/TAS 465

Tektronix' low-cost TAS series of scopes, by incorporating features from higher-end scopes, introduces a new level of power and reliability to general-purpose scopes. These instruments offer 2 input channels and bandwidths ranging from 60 MHz to 100 MHz.

STREAMLINED INTERFACE

Modeled after the successful TDS series of scopes, the TAS interface simplifies scope operation without limiting the instrument's capabilities.

You directly control important and frequently-used functions, such as horizontal and vertical position, with buttons and knobs. Secondary functions reside in menus displayed on the scope's screen. This arrangement eliminates the profusion of buttons found on most low-cost analog scopes.

For instance, to trigger most signals you simply press the "Set Level to 50%" button. The scope will set the trigger level to the midpoint of the signal. However, because varying signal levels frequently require trigger level to be adjusted, the TAS scopes have Auto Level to maintain a triggered signal.

ADVANCED FEATURES

With a comprehensive set of features, the TAS series bring leading-edge innovation to low-cost analog scopes.

Auto Setup function instantly delivers meaningful waveforms. When you press the AUTOSET button, the scope automatically adjusts the horizontal, vertical, triggering and intensity controls so you see a stable signal.

Indispensable when trying to trigger and display unknown waveforms, the auto setup feature also helps inexperienced users quickly display useful waveforms.

Cursors with readouts in the display greatly ease the task of measuring waveforms. Complete with menus, the cursors can measure delta frequency, delta time, delta volts or absolute volts from the ground reference.

Save/Recall Setup feature will store up to four front-panel setups that you can recall at a later time. With this feature you can save complex setups and recall them within seconds.

Comprehensive VideoTriggering simplifies triggering on complex video waveforms. With line, field 1 or 2, composite trigger selections and positive or negative sync, you can cleanly trigger on any NTSC, PAL or SECAM video signal.

The rugged P6109B probe is the result of years of customer research and design innovation. This passive probe has a slim, pen-like design with a patented one-piece molding made of rubber.

Besides being comfortable to handle, the probe's construction also protects its internal circuitry. Designed to withstand extreme mechanical abuse, the P6109B can endure rigorous handling while maintaining its superior measurement capabilities.

TD

Call Direct – Product available within 24 hours, (through TekDirect only). Call 1-800-426-2200. Also available through an Authorized Tektronix Distributor (listed on page 540).

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

Analog Oscilloscopes

60 MHz to 100 MHz

TAS 455
TAS 465

REMARKABLE RELIABILITY BASED ON A REMARKABLE TECHNOLOGY

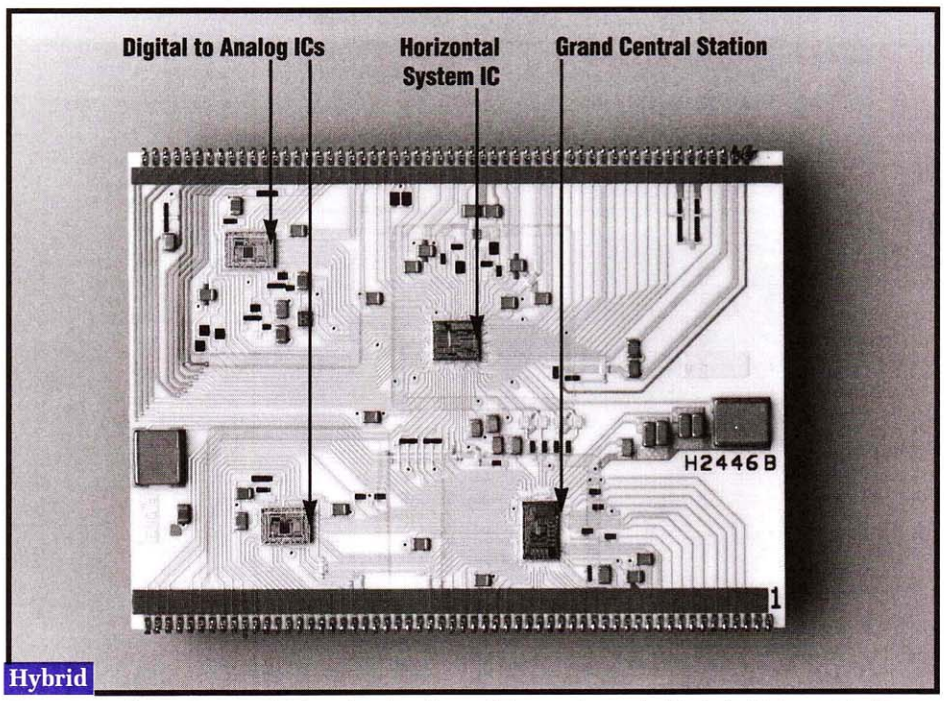
A sophisticated hybrid houses the entire acquisition system, including the vertical, horizontal and trigger functions, for each input channel. Because these hybrids dramatically reduce the scopes' parts count, the TAS 400 scopes set a new industry standard for reliability.

Furthermore, consolidating the acquisition system on the hybrid allows for extensive automatic calibration. Reducing time-to-calibrate and limiting manual calibration points translates into low maintenance costs.

ANALOG SIGNAL PROCESSING HYBRID

Two large scale (LSI) bipolar and two CMOS ICs on the hybrid house all of the vertical, horizontal and trigger functions. The first IC conditions the vertical signal controlling its position and scaling. Additionally, it embodies the channel switching and trigger coupling functions. The second IC performs the triggering and trigger logic functions. It also contains all of the horizontal functions of main and delayed sweeps, and the intensity switching and sequencing.

The two Digital to Analog ICs, developed by Tektronix specifically for the TAS 400 family, are 16 channel digital-to-analog converters (DACs). Greatly enhancing the scope's reliability, these two DAC farms replace 32 separate circuits. All the voltages for controlling trigger levels, position, offset, gain, intensity and general calibration flow from these two Digital to Analog ICs.



Containing the entire acquisition circuitry for each input channel, this hybrid dramatically increases these scopes' reliability.

Characteristics

VERTICAL SYSTEM

Frequency and Step TR Response –

Instrument	BW/Rise Time
TAS 455	60 MHz/≤ 5.8 ns
TAS 465	100 MHz/≤ 3.5 ns

Defection Factor – 2 mV/div to 5 V/div, continuously variable between V/div settings.

Deflection Factor Basic Accuracy – ±2%.

Bandwidth Limit – 20 MHz.

Input Coupling – AC, DC, GND.

Max Input Voltage – 400 V (DC + peak AC); 800 Vp-p AC at ≤10 kHz.

Input R and C – 1 MΩ ±1% in parallel with 20 pF ±2.0 pF.

Channel Isolation – ≥50 dB at 10 MHz, ≥35 dB at 100 MHz.

Vertical Modes – CH 1, CH 2; ADD, INVERT, ALT, or CHOP.

AC-Coupled Lower -3 dB Point – ≤10 Hz with a 1X probe. The AC-coupled lower frequency limits are reduced by a factor of 10 when 10X, passive probes are used.

Common Mode Rejection Ratio – ≥10:1.

HORIZONTAL SYSTEM

Main Sweep Time Base Range – 0.5 s/div to 20 ns/div (to 2 ns/div with X10 magnification).

Delayed Sweep Time Base Range – 5 ms/div to 20 ns/div (to 2 ns/div with X10 magnification).

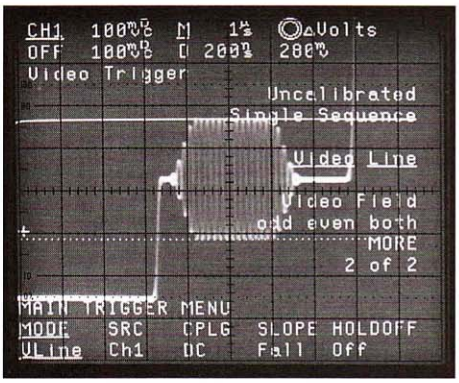
Time Base Accuracy – ±2%, ±3% magnified.

Delay Jitter – 25000 to 1 for sweep speeds <1 ms/div. 10,000 for all other sweep speeds.

Continued on next page.

TAS 455
TAS 465

Analog Oscilloscopes
60 MHz to 100 MHz



TRIGGERING

Main Mode Selections – AUTO LEVEL, (with auto baseline), AUTO, NORM, TV LINE, TV FIELD (both, odd and even), SGL, SEQ.

Delayed Mode Selections – RUNS AFTER DELAY, TRIGGERS AFTER DELAY and TV LINE (from MAIN source).

A and B Trigger Coupling – DC, HF Reject, Noise Reject, LF Reject and AC for both Main and Delayed.

Lowest Frequency for Successful Operation of "Set Level to 50%" function – 50 Hz with 1 division internal, 100 mV external (1X) or 1 V external (10X).

Trigger Source – CH 1, CH 2, Ext, Line, ADD.

Holdoff Control Range – Increases Main sweep holdoff time by a factor of at least 10.

External Trigger Input Impedance – 1 MΩ ±2% in parallel with 20 pF ±2.0 pF.

Maximum Input Voltage – +400 V (DC + peak AC); 800 Vp-p AC at ≤10 kHz.

Trigger Sensitivity – DC: 0.30 division from DC to 25 MHz, increasing linearly to 1 div at 150 MHz.

Noise Reject: 1.2 division from DC to 25 MHz, increasing linearly to 2.2 divisions at 150 MHz.

HF REJ: 0.30 div from DC to 10 kHz; attenuates signals above the upper –3 dB cutoff frequency of 50 kHz.

LF REJ: 0.30 div from 100 kHz to 25 MHz; increasing linearly to 1.0 division at 150 MHz; attenuates signals below the lower –3 dB cutoff frequency of 50 KHz.

AC: 0.30 division from 350 Hz to 25 MHz, increasing linearly to 1.0 division at 150 MHz; attenuates signals below the –3 dB cutoff frequency of 160 Hz.

X-Y OPERATION

Sensitivity Range – Same as Vertical Deflection System.

XY Accuracy – ±4%.

X-Axis Bandwidth – DC to at least 3 MHz.

Phase Difference Between X and Y – ±3° DC to 150 kHz.

PROBE COMPENSATOR OUTPUT

Output Voltage – 5 V (base to top) into at 1 MΩ load.

Frequency – 1 kHz ±5%.

Typical Rise Time – ≤500 ns.

Typical Aberrations – ≤=1% after the first 500 ns following the square wave transition.

NONVOLATILE SETUP MEMORY

Number of Nonvolatile Setups – 4.

Memories Retention Time – Internal batteries, installed at the time of manufacture have a life of ≥10 years when operated and stored at an ambient temperature from 0°C to +50°C. Retention time is equal to the remaining life of the batteries.

CURSORS

Cursor Functions – ΔVolts, absolute Volts, time and frequency.

Accuracy –

Cursor Type	Accuracy
Time	±(0.5% of reading + 2% of one horizontal division).
Frequency	Readouts calculated using SEC cursor difference
Volts	±(1% of reading + 2% of one vertical division + HF display errors + trace shift errors).
Δ Volts	±(1% of reading + 2% of one vertical division + HF display errors).

Analog Oscilloscopes

60 MHz to 100 MHz

TAS 455
TAS 465

POWER REQUIREMENTS

Line Voltage Ranges – 115 V: 90-132 VAC rms. 230 V: 180-250 VAC rms.

Line Frequency – 48 to 440 Hz.

Maximum Power Consumption– ≤ 85 Watts.

ENVIRONMENTAL AND SAFETY

The TAS series scopes are designed to meet specific environmental conditions as described in MIL-T-28800E for Type III, Class 3, Style D equipment as specified below. Other environmental specifications are available.

Temperature – –10°C to +55°C (operating); –51°C to +71°C (non-operating).

Humidity – Operating and non-operating, up to 95% RH at or below +55°C.

Altitude – 15,000 ft/4572 m (operating); 50,000 ft/15240 m (non-operating).

Random Vibration – 0.31 g rms (operating) 2.46 g rms (non-operating), from 5 to 500 Hz, 10 minutes each axis.

Electrostatic Discharge Susceptibility – Up to 8 kV with no change to control settings, or lower cost impairment of normal operation; up to 15 kV with no damage that prevents recovery of normal operation by the user.

Safety – UL 1244 Listed, CSA 556B certified, IEC 348.

Emissions – VFG 243; FCC Rules and Regulations, Part 15, Subpart J, Class A.

Cooling Method – Forced-air circulation with no air filter.

PHYSICAL CHARACTERISTICS

	Cabinet		Rackmount[1]	
Dimensions	**mm**	**in.**	**mm**	**in.**
Width (with handle)	362	14.25	483	19
Height (with feet pouch)	191	7.5	178	7
(without pouch)	165	6.5		
Depth	471	18.55	472	18.6
(with front cover)	490	19.28		
(handle extended)	564	22.20	517	20.35
	kg	**lb**	**kg**	**lb**
Weight	7.7	17		
Net with accessories and pouch	9.3	20.5	4.5	10
Domestic Shipping	13.6	30	15.4	33.9

[1] Weight of conversion kit only. The rear support kit adds 7.3 kg/16 lbs.

ORDERING INFORMATION

TAS 455

60 MHz Oscilloscope. ..... TD **$1,540**

Includes: Two 10X Voltage Probes (P6109B); Instruction Manual (070-8523-00); Reference (070-8522-00); XYZ's of Oscilloscopes: Analog and Digital Concepts (070-8690-00).

Opt. 02 – Front Cover and Pouch ..... **+$60**
Opt. 3R – Rackmount Kit ..... **+$350**
Opt. 23 – 2 ea. P6129B Probes ..... **+$190**
Opt. 9C – Calibration Certification/Test Data ..... **+$125**

TAS 465

100 MHz Oscilloscope. ..... TD **$2,195**

Includes: Two 10X Voltage Probes (P6109B); Instruction Manual (070-8523-00); Reference (070-8522-00); XYZ's of Oscilloscopes: Analog and Digital Concepts (070-8690-00).

Opt. 02 – Front Cover and Pouch ..... **+$60**
Opt. 3R – Rackmount Kit ..... **+$350**
Opt. 23 – 2 ea. P6129B Probes ..... **+$190**
Opt. 9C – Calibration Certification/Test Data ..... **+$125**

WARRANTY-PLUS SERVICE OPTIONS

Opt. M2 – Repair Protection
TAS 455 ..... **+$125**
TAS 465 ..... **+$150**

Opt. M8 – Calibration Service
TAS 455 ..... **+$125**
TAS 465 ..... **+$150**

INTERNATIONAL POWER PLUG OPTIONS

Opt. A1 – Universal Euro 220 V, 50 Hz ..... **NC**
Opt. A2 – United Kingdom 240 V, 50 Hz ..... **NC**
Opt. A3 – Australian 240 V, 50 Hz ..... **NC**
Opt. A4 – North American 240 V, 60 Hz ..... **NC**
Opt. A5 – Switzerland 220 V, 50 Hz ..... **NC**

PROBES

Differential –
100 MHz, active differential, 6 ft. Order P6046 ..... **$2,195**

High Voltage –
100X, 120 MHz, 1500 V, 2.5 pF/10 MΩ, 9 ft. Order P6009 ..... **$265**
1000X, 75 MHz, 20 kV, 3.0 pF/100 MΩ, 10 ft. Order P6015A **$895**

General Purpose –
1X, 15 MHz, 100 pF/1 MΩ, 2 m. Order P6101B **$60**
10X, 100 MHz, 13.2 pF/10 MΩ, 2 m. Order P6109B **$70**
1X-10X Switchable, 1X: 10 MHz, 100 pF/1 MΩ.
10X: 100 MHz, 18 pF/10 MΩ, 2 m. Order P6129B **$95**

Logic –
20 MHz, 17 bit, word recognizer/trigger. Order P6408 ..... **$425**

Digital Timing Demodulator –
Order TVC501 ..... **$2,495**

Current –
935 Hz to 120 MHz, 3 A continuous peak. Order P6022 ..... **$595**
120 Hz to 60 MHz, 7.5 A continuous peak. Order P6021 ..... **$545**
DC to 50 MHz System, includes AM503A, A6302 20 A probe, TM502A Order AM503S **$2,595**

CART – Order K212 ..... **$395**
CAMERA – Order C9 Opt. 06 ..... **$470**

TD
Call Direct – Product available within 24 hours, (through TekDirect only). Call 1-800-426-2200. Also available through an Authorized Tektronix Distributor (listed on page 540).

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

2467B
2467BHD

2465B
2445B

Analog Oscilloscopes

200 MHz to 400 MHz

Convenient and easy setup and measurements.

2445B/2465B

- Four Channels
- Up to 400 MHz Bandwidth
- Up to 500 ps/div Timing Resolution
- Auto Setup
- Automatic Measurements
- Save and Recall Front-panel Setups
- Cursor Measurements
- 1% Timing Accuracy
- 3 Year Warranty

2467B

- Includes all the 2465B functionality
- Bright Microchannel Plate Display (MCP)

2467BHD

- Includes all of the above 2465B functionality plus a MCP Display
- Opt. 5H Tri-level Sync Triggering for HDTV Video Signals
- Opt. 06 Counter/Timer/Trigger

APPLICATIONS

- Troubleshooting (2400B Series)
- Laser and Radar Pulses (2400B Series)
- Video Equipment Design (2467BHD)
- Disk Drive Testing (2467B)
- Advanced Imaging (2467BHD)
- Service (2400B Series)

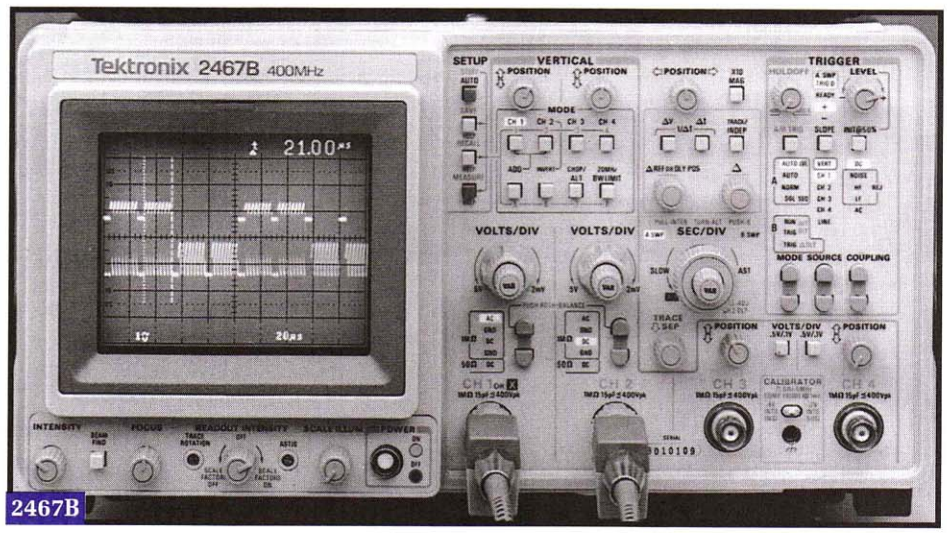
TD

2465B/2445B and Opt. 05 also available within 24 hours through TekDirect. Call 1-800-426-2200

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

GPIB IEEE-488

The 2467B, 2465B, and 2445B comply with Opt. 10 with IEEE Standard 488.1-1987, and with Tektronix Standard Codes and Formats.

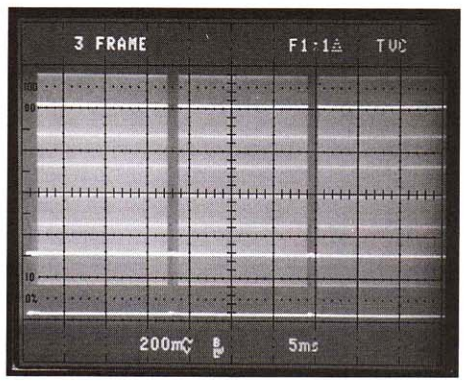


2467B

Power of Analog

Recognizing that digital and analog scopes have different strengths, Tektronix designs and manufactures both analog and digitizing oscilloscopes so you can choose the right scope for your application and budget.

Although digital scopes feature many attractive capabilities, for a variety of applications analog scopes offer unique benefits that most digitizing scopes can't match.



Grey Scaling and Persistence

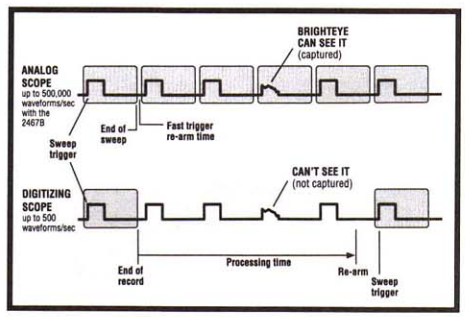
With an analog display, faster signals appear fainter than slower signals. Called grey scaling, this phenomenon gives important clues about relative frequencies when analyzing mixes or overlayed signals like video waveforms.

Or when an event only occurs occasionally in a repetitive signal, the anomaly will fade quicker and look dimmer than the rest of the waveform. This persistence effect reveals critical information when analyzing and debugging complex analog designs, such as switching power supplies.

Real-Time Display

The display on an analog scope responds instantly to changing signal conditions. Unlike digital scopes that need to acquire and process signal information before displaying, analog scopes simply attenuate or amplify the input signal directly onto the display.

As a result, analog scopes can trigger on many more waveforms per second than a digital scope. For instance, the 2467 BrightEye acquires up to 500,000 waveforms/sec. As a result, an analog scope updates its display so quickly that you literally see waveform behavior as it happens.



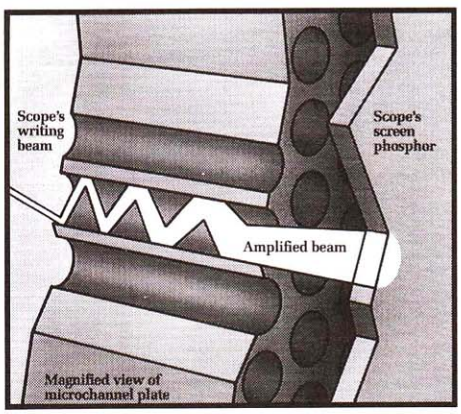
Analog Oscilloscopes

200 MHz to 400 MHz

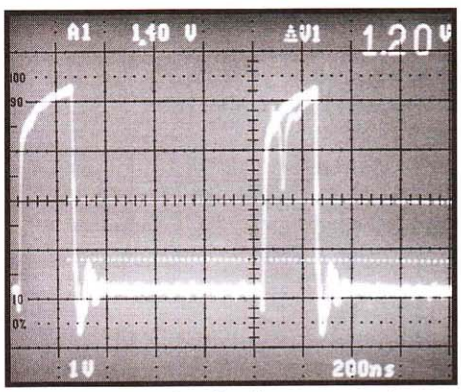
2467B	2465B
2467BHD	2445B

BrightEye® Display

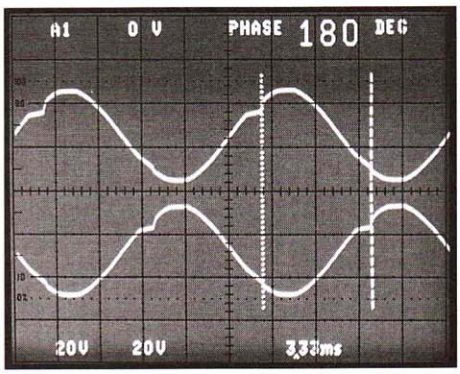
Sometimes grey scaling and persistence create such faint signals, you can have difficulty seeing them on ordinary scopes. In response to this problem, the 2467B BrightEye® includes a revolutionary new display, the microchannel plate (MCP), that can increase the intensity of a dim waveform up to a thousand times.



This MCP technology makes it possible to see a single sweep even at 500 picosec/div without a viewing hood. Even those difficult to find logic errors or metastability problems in a repetitive signal environment are easily seen.



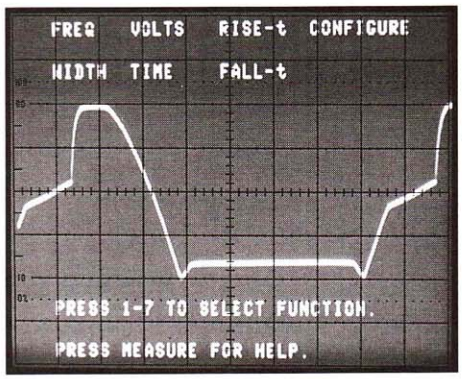
Metastability in this flip-flop occurs only once in a million normal cycles, yet it is clearly visible due to the 2467B's high visible writing speed.



With the delta-time and voltage cursors, you can measure a waveform's parameters including phase.

Fully Independent Cursors

Fully independent delta-time and voltage cursors with readouts streamline display measurements.



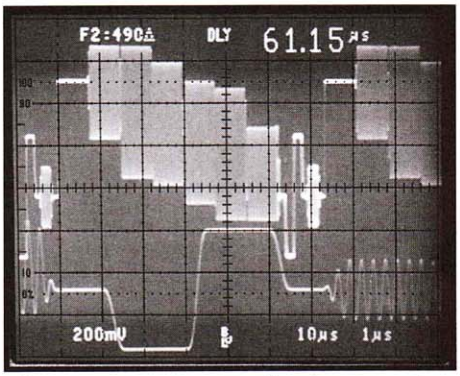
Select from a variety of automatic measurement choices included with all the 2400B series scopes.

The Simplicity of Automated Control

2400B series automates several key functions so you can easily access the powerful capabilities of these scopes.

STRAIGHTFORWARD SETUP

To quickly locate and display undefined or complex signals, simply press AUTO SETUP. This function automatically triggers, scales and positions waveforms from any or all of the input channels.



The 2467BHD automatically triggers on tri-level sync pulses used in high-definition video signals. Note: Line Count Readout Displays Field 2 – Line #490.

ADVANCED TRIGGERING

With a complete selection of trigger modes, the 2400B series scopes can display any signal regardless of its complexity. The auto level function maintains a stable waveform display even as input signals change so you can view variable-voltage signals clearly without irritating jitter.

To noticeably improve the accuracy of timing measurements, press the INIT @50% selection and the scope will maintain the trigger level at the input signal's 50% voltage level.

Choose AC or DC coupling and reject high or low frequencies or noise to clarify the waveform display.

HDTV Analysis Made Easy

Built on the 2467B BrightEye platform, the 2467BHD applies the power of MCP technology to the acquisition of high-definition video signals.

The 400 MHz 2467BHD can automatically recognize tri-level sync pulses on any of the proposed HDTV standards, including 1250/50, 1125/60 and 1050/60 formats.

This scope, by including option 5H, clearly displays high-definition video signals with an unequalled frequency response flatness rating of ±2% over the first 30 MHz. To display signals even more clearly, you can significantly attenuate noise or clock frequency interference with the 50 MHz bandwidth limit selection.

A built-in counter/timer/trigger (Option 06) will help you make vital timing measurements as accurately as possible. And with its 500 ps/div sweep rate, the 2467BHD will capture and display a high-definition signal's fastest transients.

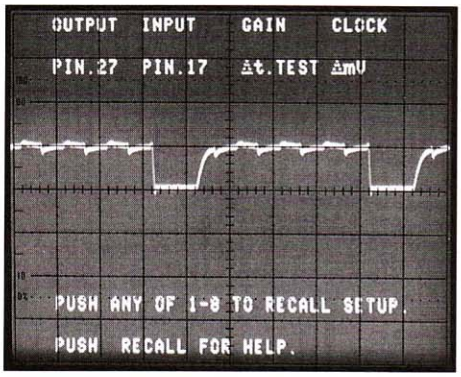
Continued on next page.

2467B
2467BHD

2465B
2445B

Analog Oscilloscopes

200 MHz to 400 MHz



Create measurement sequences using the front panel controls for semi-automated testing.

Streamlined Front-Panel Setups

Just press SAVE SETUP to save a front-panel setup instead of recreating it again and again. The scope instantly stores all front panel information, including intensity, cursor locations and control settings. And you label each setup with a descriptive name.

The 2400B series scopes will retain up to 30 front-panel setups in non-volatile memory until you decide to replace or delete them.

Easy Automation

With built-in sequencing, you can develop a custom test series without writing a line of code. First save and label a series of front-panel setup, each representing a step in the test procedure. Then link the steps in any order you want.

To execute your custom test series, press STEP to sequence through the individual steps. This is extremely useful for manufacturing evaluation and device characterization. You'll appreciate the ease and efficiency of the 2400B series automatic sequencing.

2400B Series Options

The following options are not retrofittable on standard products after purchase.

VIDEO WAVEFORM MEASUREMENT SYSTEM (OPTION 05)

Tailors the 2445B, 2465B and 2467B for applications involving broadcast and cable television, graphics displays and raster-scan systems. It enables CRT readout of the line number of field selected for triggering, so the operator knows exactly what the display represents.

Sync Separation: Stable sync separation from sync-positive or sync-negative composite video on systems with 525 to 1280 lines, 50 Hz or 60 Hz, interlaced or noninterlaced.

Trigger Modes: Lines, FLD 1, FLD 2, ALT (FLD 1/FLD 2).

Back Porch Clamp: Within 1.0 div of the ground reference.

HIGH-DEFINITION TELEVISION (OPTION 5H)

Only available with the 2467B scope and standard in the 2467BHD, this option lets you trigger on tri-level sync pulses, automatically senses the HDTV standard being used and autosets itself accordingly.

Stable Sync Separation: From tri-level and bi-level sync-positive or sync-negative composite or component video on systems with 525 to 1280 lines per frame, 50 Hz or 60 Hz field rate, interlaced or non interlaced.

HD Video Triggering Modes: Lines, FLD 1, FLD 2, ALT (FLD 1/FLD 2), and the Active Video Mode.

Standard TV Presets: Lines, fields, frames, line select, active video, horizontal blanking, vertical blanking, pixel and TSG triggering.

Bandwidth Limiter: Reduces the upper –3 dB to 50 MHz.

Frequency Response (–3 dB 400 MHz) Flatness: ±1% for 50 kHz to 100 MHz, ±1%-2% for 10 MHz to 20 MHz, ±2% for 20 MHz to 30 MHz.

Counter/Timer/Trigger (CTT) (Option 06) And CTT/Word Recognizer (Option 09)

These options feature a crystal-controlled timebase with 0.001% accuracy. Option 09 adds a word recognizer. Useful when probing TTL-compatible logic families, this 17-bit word recognizer is operable up to 20 MHz with an external clock and up to 10 MHz with the internal clock.

These options also feature a 7-digit CRT readout display for Frequency (0.5 Hz to 150 MHz), Period (6.666667 ns to 2 s), Totalize (to 9,999,999) and Delay by Events triggering (up to 4,194,303).

GPIB Interface (Option 10)

Functions implemented include SH1, AH1, T6, L3, SR1, RL1, CD1, E1, DT0, C0 and PP0.

Characteristics

For more detailed specifications, contact any Tektronix Sales Office or authorized Tektronix distributor near you.

VERTICAL SYSTEM

Deflection Factor: 2 mV/div to 5 V/div, continuously variable between V/div settings (CH 1 and CH 2). 100 mV/div and 500 mV/div (CH 3 and CH 4).

Deflection Factor Basic Accuracy: ±2%, measured at any V/div with a 4- or 5-div signal, centered on screen (CH 1 and CH 2). ±10% (CH 3 and CH 4) between 15°C and 35°C.

Frequency and Step Tr Response (–3 dB Bandwidth)/(Tr = 0.35/BW)

Instrument	BW/Rise Time
2445B	200 MHz/1.75 ns
2465B/ 2467B/ 2467BHD	400 MHz/0.875 ns (≥ 5 mV/div), and 350 MHz/1 ns (2 mV/div)

Measured with a standard accessory probe or internal 50 Ω termination.

Bandwidth Limiter: Reduces upper –3 dB to 20 MHz for 2445B, 2465B and 2467B. Reduces upper –3 dB to 50 MHz for 2467BHD.

Input Coupling and Max Voltage: (1 MΩ) AC, DC, GND; Max input voltage: 400 V (DC + peak AC). (50 Ω) Max input voltage: 5 V RMS average for 1 sec, ±50 V peak.

Input R and C: 1 MΩ ±5% and 15 pF ±2 pF or 50 Ω (nominal).

Channel Isolation: ≥100:1 at 100 MHz, ≥50:1 at nominal bandwidth (CH 1, CH 2), ≥50:1 at 100 MHz (CH 3, CH 4).

AC-Coupled Lower -3 dB Point: 10 Hz or less. 1 Hz or less with standard accessory probe.

Chop Mode Switching Rate: 2.5 MHz ±0.2% (20 µs/div to 2 µs/div). 1 MHz ±0.2% for all other sweep speeds.

A Sweep Timing Accuracy

For 100 ms/div and faster settings, +15°C to +35°C, X10 magnification not enabled.

Method	Accuracy
A Sweep	±(0.7% of time interval +0.6% of full scale)
ΔT using cursors	±(0.5% of time interval +0.3% of full scale)
ΔT using delay	±(0.3% of time interval sweep +0.1% of full scale +200 ps)
Delay from A trig to B sweep	±(0.3% of time interval +0.6% of full scale +0 to -25 ns)

Analog Oscilloscopes

200 MHz to 400 MHz

2467B | **2465B**
2467BHD | **2445B**

HORIZONTAL SYSTEM

Display Modes: A (main sweep), A INTENsified, ALTernate, A INTEN with B (delayed sweep) and B. In X-Y mode, CH 1 provides X-axis (horizontal) deflection.

A Sweep Time Base Range: 2445B: 500 ms/div to 10 ns/div (to 1 ns/div with X10 magnification).

2465B/2467B/2467BHD: 500 ms/div to 5 ns/div (to 500 ps/div with X10 magnification).

B Sweep Time Base Range: 2445B: 50 ms/div to 10 ns/div (to 1 ns/div with X10 magnification).

2465B/2467B/2467BHD: 50 ms/div to 5 ns/div (to 500 ps/div with X10 magnification).

Variable Timing Control: Continuously variable and calibrated (add 2% of time interval timing accuracy) between SEC/DIV settings. Extends slowest A Sweep to 1.5 s/div. Change the A sweep's sec/div setting with the A display mode selected. Change the B sweep's sec/div with INTEN, ALT and B Modes selected. When VAR control is out of detent, the ΔT cursors measure RATIO (with 5 divisions being 100%) and 1/ΔT cursors measure PHASE (five divisions being 360°).

Displayed CH 2 Signal Delay with Respect to CH 1: Adjustable ±500 ps.

Delay Jitter: Within 0.004% (one part or less in 25,000) of maximum available delay plus 50 ps (2445B/2465B). Within 0.01% (one part or less in 10,000) of maximum available delay plus 100 ps (2467B/2467BHD).

ACCURACY SPECIFICATIONS FOR AUTOMATIC MEASUREMENTS

(Excluding 2467BHD counter measurements—see Opt. 06 for specs.)

For +15°C to +35°C, specifications are based on noise less than 0.1% of a peak-to-peak input waveform.

Period: 0.5% + 500 ps + jitter error.

Volts: 5% +5 mV + (0.5 mV times probe attenuation) + signal aberrations + 1 LSD to 1 MHz (minimum width at peak amplitude ≤ 10 ns).

Rise time, Fall time: 5% + 3 ns (for transition times greater than 5 ns). These rise and fall times are based on measurements of 20% to 80%, extrapolated to 10% and 90% (pulse overshoot and pulse undershoot less than 5% of peak-to-peak signal).

Time A-B (from % to %): 0.5% + 3 ns (+ 0.5 ns if measuring from CH 1 to CH 2) + 5% of start event + 5% of stop event transition times.

Time A-B (between two voltages): 0.9% + 3 ns (+ 0.5 ns if measuring from CH 1 to CH 2) + 5% of start event + 5% of stop event transition.

Pulse Width: 0.9% + 1 ns + jitter error + 2X offset error (transition times less than 10% of measured interval).

TRIGGERING

A and B Trigger Coupling: DC, Noise Reject, HF Reject, LF Reject, AC.

Trigger Level Range: ±18 times V/div setting for CH 1 and CH 2. ±9 times V/div setting for CH 3 and CH 4.

Trigger Sensitivity to 50 MHz from CH 1 or CH 2: 0.35 div DC coupled; ≤1.2 div noise reject coupled; 0.5 div from DC to 30 kHz HF reject coupled; 0.5 divs from 80 kHz LF reject coupled; 0.35 divs from 60 Hz AC coupled.

For above 50 MHz, DC, LF reject and AC coupling, the triggering signal requirement increases to 1.5 divs at 500 MHz (2465B/2467B/2467BHD) and at 250 MHz (2445B).

For noise reject coupling above 50 MHz, the triggering signal requirement increases to 4.5 divs at 500 MHz (2465B/2467B/2467BHD) and at 250 MHz (2445B).

Triggering Sensitivity from CH 3 or CH 4: One half the CH 1 or CH 2 requirements.

LEVEL Control Range: ±18 times the V/div setting for CH 1 or CH 2; ±9 times the V/div setting for CH 3 or CH 4.

LEVEL Readout Basic Accuracy: ±[3% of setting + 3% of p-p signal + 0.2 div + 0.5 mV + (0.5 mV times probe attenuation factor)] for CH 1 or CH 2; ±[3% of setting + 4% of p-p signal + 0.1 div + (0.5 mV times probe attenuation factor)] for CH 1 or CH 2.

Basic accuracies apply from +15°C to +35°C and are measured with triggering signals having transition times greater than 20 ns with 1 MΩ input, DC trigger coupling.

X-Y OPERATION

X-Axis Deflection Factor Range, Variable Range, and Accuracy: Same as CH 1.

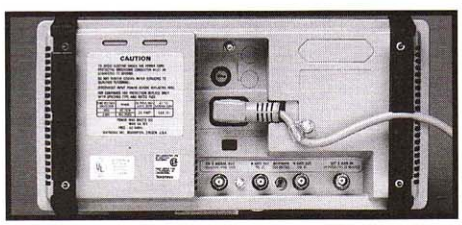
X-Axis Bandwidth: DC to 3 MHz.

Phase Difference Between X and Y: ≤1° from DC to 1 MHz. ≤3° from 1 MHz to 2 MHz.

OTHER SIGNAL INPUTS AND OUTPUTS

Inputs include: Z-axis and AUTO/SETUP control.

Outputs include: CH 2 Signal Out, A Gate Out, B Gate Out and Calibrator/Probe Compensation output.



DISPLAY

Graticule Size: 2445B/2465B: 80 mm x 100 mm 2467B/2467BHD: 68 mm x 85 mm.

Standard Phosphor: GH(P31).

Cursors: ΔVolts, ΔTime, 1/ΔTime, Ratio, Phase, and %.

POWER REQUIREMENTS

Line-Voltage Ranges: 115 V: 90 to 132 VAC. 230 V: 180 to 250 AC.

Line Frequency: 48 to 440 Hz.

Maximum Power Consumption: 120 W (180 VA) for a fully optioned instrument.

ENVIRONMENTAL AND SAFETY

The 2400B scopes meet the environmental conditions described in MIL-T-28800D for Type III, Class 3, Style D equipment as specified below. Other environmental specifications are available.

Temperature: –15°C to +55°C (operating); –62°C to +85°C (non-operating).

Humidity: Operating and non-operating, up to 95% RH at or below +40°C; to 75% RH from +41° to +50°C.

Altitude: 15,000 ft (op); 50,000 ft (non-op).

Safety: UL 1244 Listed, CSA 556B certified.

PHYSICAL CHARACTERISTICS

	2445B/ 2465B	2467B/ 2467BHD	Rackmount[1]
Dimensions	**mm/in.**	**mm/in.**	**mm/in.**
Width w/handle	338/13.3	338/13.3	483/19.0
Height with feet & pouch	190/7.5	190/7.5	178/7.0
w/o pouch	160/6.3	160/6.3	
Depth with front cover	434/17.1	472/18.6	419/16.5
Handle extended	508/20.0	533/21.0	
Weight	**kg/lb**	**kg/lb**	**kg/lb**
Net with accessories and pouch	10.2/22.5	10.9/24.0	4.0/8.8
w/o accessories & pouch	9.3/20.5	9.7/21.3	
Domestic Shipping	12.8/28.2	14.6/32.1	6.3/13.8

[1]*Weight of conversion kit only. Rear support kit weight is an additional 6.3 kg/13.8 lb.*

Continued on next page.

2467B
2467BHD

2465B
2445B

Analog Oscilloscopes
200 MHz to 400 MHz

ORDERING INFORMATION

2467B
400 MHz Oscilloscope with Microchannel Plate Display **$12,995**
Includes: Four P6137 10x Probes with Accessories fuse (159-0021-00); Banana Plug/Binding Post Adapter (134-0016-01); Snap Accessory Pouch (016-0692-01); Operators Manual (070-6861-01); Front cover (200-3199-01).

2465B
400 MHz Oscilloscope ..... TD **$6,895**

2445B
200 MHz Oscilloscope ..... TD **$4,995**
Both Include: Two P6137 10x Probes with Accessories Fuse (159-0021-00); Banana Plug/Binding Post Adapter (134-0016-01); Snap Accessory Pouch (016-0692-01); Operators Manual (070-6860-00); CRT Filter/Clear (378-0208-00); Front Cover (200-3199-01); Power Cord (161-0104-00).

2467BHD (Special Configuration for Video)
400 MHz HDTV Oscilloscope **$14,995**
Includes: same as 2467B plus: CCIR Graticule Filter (378-0270-01); NTSC Graticule Filter (378-0270-02); Polarized Viewing Hood (016-0180-00); Three 75 Ω Terminators (011-0055-00).

Instrument Options are not retrofittable after purchase.

Opt. 05 – Video Waveform Measurement System for bi-level sync formats. ..... TD **+$995**

Opt. 5H – High-Definition Television (2467B only) ..... **+$1,595**
Available also as the 2467BHD oscilloscope.

Opt. 06 – Counter/Timer/Trigger. ..... **+$1,295**

Opt. 09 – Counter/Timer/Trigger with Word Recognizer. ..... **+$1,995**

Opt. 10 – IEEE-488 GPIB Interface. ..... **+$995**

Opt. 11 – Rear panel probe power. For P6201 and P6202A. (Cannot be ordered with Opt. 09) ..... **+$225**

Opt. B1 – Service Manual for standard 2465B and 2467B (070-6863-00) and for standard 2445B (070-6862-00) ..... **+$120**

Opt. B2 – Service Manual for any of the above options, including the 2467BHD (070-6864-00). ..... **+$120**

Opt. 1R – Instrument configured for rackmount. Includes slideout assemblies. ..... **+405**

Opt. 1T – Transit Case (202-0302-00) with telescoping handle and retractable wheels. ..... **+$407**

Opt. 22 – Two additional matching probes (P6137). (standard with 2467B and 2467BHD) ..... **+$390**

INTERNATIONAL POWER PLUG OPTIONS
Opt. A1 – Universal Euro, 220 V, 50 Hz. ..... **NC**
Opt. A2 – United Kingdom, 240 V, 50 Hz. ..... **NC**
Opt. A3 – Australian, 240 V, 50 Hz. ..... **NC**
Opt. A4 – North American, 240 V, 60 Hz. ..... **NC**
Opt. A5 – Swiss, 220 V, 50 Hz. ..... **NC**

See General Customer Information Section for additional description.

WARRANTY-PLUS SERVICE OPTIONS
Opt. M2 – Repair Protection
2467B ..... **+$390**
2467BHD ..... **+$450**
2465B ..... **+$260**
2445B ..... **+$220**

Opt. M8 – Calibration Service
2467B ..... **+$390**
2467BHD ..... **+$450**
2465B ..... **+$260**
2445B ..... **+$220**

SOFTWARE
Additional information in the Software section.

EZ-TEST PC Test Development Software – Requires GPIB-equipped instruments; used with Tektronix 2402A or IBM PC/XT/AT and compatibles (computer must also have GPIB). Order S45F030 ..... **$995**

PROBES
See Page 423 for complete Probe selection.

Passive (1 MΩ) –
10X, 400 MHz, compact tip. Order P6137 ..... **$195**

Active – 1X, 10X, 100X FET Probe, 900 MHz. Order P6201 ..... **$1,495**

Low Impedance (50 Ω) – 10X Low Impedance, 3.5 GHz, 1X, 20X, 100X. Order P6156 Opt. 28 ..... **$445**

Current – 50A MHz, 20A (DC + pk AC). Order AM 503S **$2,595**
15 MHz, 100A (DC + pk AC) Order AM 503S Opt. 03 ..... **$3,240**
15A (p-p). Order P6021 ..... **$545**
6A (p-p). Order P6022 ..... **$595**

High Voltage – 120 MHz, 1500 V pk. Order P6009 ..... **$265**
75 MHz, 40 kV pk. Order P6015A Opt. 1R **$950**

Differential – Order P6046. ..... **$2,195**

Digital Timing Demodulator – Order TVC501 ..... **$2,495**

CARTS
Portable Instrument – Order K212 ..... **$395**
with Plotter Shelf – Order K212 Opt. 22 ..... **$540**

CAMERAS
High Performance – Order C-9 ..... **$470**
Digitizing – Order DCS01 Opt. 2A **$6,025**

ADDITIONAL ACCESSORIES
Optical to Electrical Converters – 450-1050 nanometers, 700 MHz (requires 1103 Probe Power Supply). Order P6701A *1

450-1050 nanometers, 250 MHz, High Gain, (requires 1103 Probe Power Supply). Order P6711 ..... *1

1000-1700 nanometers, 500 MHz (requires 1103 Probe Power Supply). Order P6703A *1

1100-1700 nanometers, 300 MHz, High Gain, (requires 1103 Probe Power Supply). Order P6713 ..... *1

Power Supply – For up to two optical probes. Order 1103 ..... **$495**

Isolator – Two independently-isolated channels, 20 MHz, 3000 VAC. Order A6902B Opt. 02 ..... **$2,960**

Ground Isolation Monitor – Order A6901 ..... **$1,800**

SMT Interconnects – SMT KlipChip™ for surface-mount devices (requires 013-0202-02). Order SMGK52 ..... **$80**

SOIC Engineering Kit Small Outline Integrated Circuits (8,14,16, 20, 24 pins). Order SMCK1 ..... **$99**

PLCC Engineering Kit Plastic Leader Chip Carriers (20, 28, 44, 52, 68, 84 pins). Order SMQK1 ..... **$270**

Carrying Cases – Telescoping handle, retractable wheels. Order 202-0302-00 ..... **$570**

Carrying Strap – Over-the-shoulder. Order 346-0119-00 ..... *1

Rackmount Conversion Kit – Order 016-0825-01 ..... **$405**

Cables – GPIB, Double Shield Low EMI.
(1 m) – Order 012-0991-01 ..... **$170**
(2 m) – Order 012-0991-00 ..... **$170**
(3 m) – Order 012-0991-02 ..... **$260**

Viewing Hood – Collapsible Polaroid. Order 016-0180-00 ..... **$80**

Manuals – Service
(2465B, 2467B, 2467BHD). Order 070-6863-00 ..... **$120**
(2445B). Order 070-6864-00 ..... **$120**
(Scope Opt.). Order 070-6864-00 ..... **$120**

*1 *Contact your local Tektronix representative for price information.*

TD
2465B/2445B and Opt. 05 also available within 24 hours through TekDirect. Call 1-800-426-2200

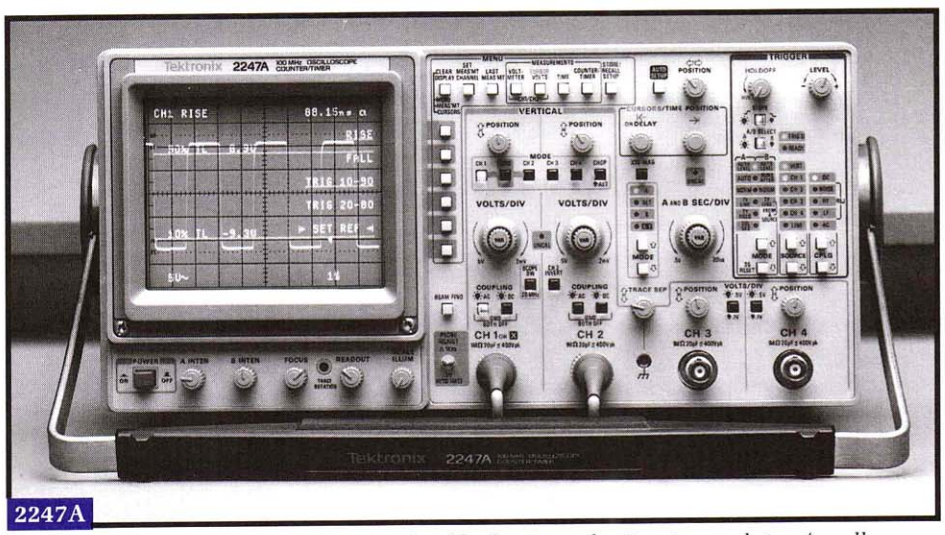
To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

GPIB IEEE-488
The 2467B, 2465B, and 2445B comply with Opt. 10 with IEEE Standard 488.1-1987, and with Tektronix Standard Codes and Formats.

Dual Time Base Oscilloscopes

100 MHz

2245A
2247A
2252



2247A

2247A: Packed with time saving automation like front panel auto setup and store/recall. Automatic measurements are push-button simple using the integrated digital voltmeter and precision counter/timer.

2252, 2247A, 2245A Dual Time Base Oscilloscopes

When productivity, performance, and low cost really count, nothing beats the 2245A, 2247A, and new 2252 line of portable oscilloscopes. These four-channel, dual time base oscilloscopes are top-of-their-class in automation and versatility, becoming the industry standard in 100 MHz real-time performance. Such capabilities as 2 ns/division time base, 2 mV/division vertical sensitivity, and advanced trigger modes assure you solutions for your design, testing, and service tasks.

AUTOMATIC FRONT PANEL SETUP

All these oscilloscopes offer single button setup. Just press the AutoSet key and vertical, horizontal, triggering and display controls are automatically adjusted to display a waveform. In seconds, a stable, triggered display of your waveform appears on-screen, ready to measure.

STORE/RECALL MEMORY

For even greater versatility in setup, the 2247A and 2252 offer store/recall of 20 front panel setups. Current front panel settings can be stored in non-volatile memory, then recalled when and where they are needed. Switching between setups is easy – just two buttons recall a complete setup, including selected measurements and operator prompts. For repetitive testing or service diagnostics, store/recall settings can even be used in sequence to step through a predetermined series of tasks.

ADVANCED REAL-TIME MEASUREMENTS

Each have cursors for making time, frequency and voltage measurements pushbutton simple. CRT readout gives you a numerical display of the waveform parameter you are measuring. There is no need for arithmetic or counting of graticule divisions.

The 2247A and 2252 further integrate advanced measurement capability with a built-in digital voltmeter and a precision counter/timer. These integrated tools provide a complement of automatic measurements at your fingertips.

Continued on next page.

2252, 2247A, 2245A

- Four Independent Channels
- Auto Setup of Instrument Front Panel
- Dual Time Base with Delayed Sweep
- Cursor Time/Voltage Measurements
- On-Screen Scale Factor Readouts

2247A

- Hands-Off Voltmeter Measurements
- SmartCursor™ Track Voltmeter Measurements
- Integrated Counter/Timer
- Phase Measurements
- Automatic Rise/Fall Time and Propagation Delay Time Measurements
- Store/Recall of 20 Front Panel Setups

2252

All the features of 2247A, plus:

- Push-Button Hardcopy Output
- Centronics Interface
- Fully GPIB Programmable

Smart Scopes with 100 MHz, Four Channels, and Advanced Features like Auto Setup, Tracking Cursors, Voltmeter, Integrated Counter/Timer, and Store/Recall of Front Panel Setups.

Automation made easy with full programmability, digitized waveform hardcopy, and push-button measurements.

TD

Call Direct – Product available within 24 hours, (through TekDirect only). Call 1-800-426-2200. Also available through an Authorized Tektronix Distributor (listed on page 540).

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

GPIB IEEE-488 — The 2252 complies with IEEE Standard 488.2-1988, and with Tektronix Standard Codes and Formats.

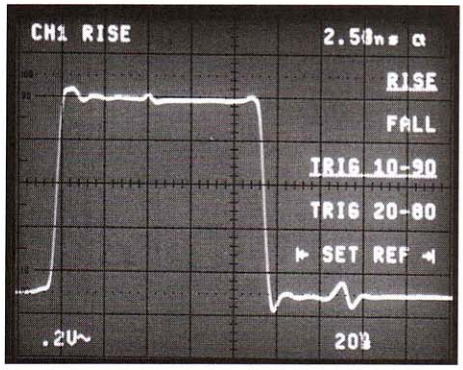
2245A
2247A
2252

Dual Time Base Oscilloscopes

100 MHz

SELECTION GUIDE

Features	Bandwidth	Channels	Time Base	Auto Setup	Cursors	Store/ Recall	Digital Voltmeter	Counter/ Timer	Program-mability	Hardcopy Output
2245A	100 MHz	4	Dual	Yes	Yes	No	No	No	No	No
2247A	100 MHz	4	Dual	Yes	Yes	Yes	Yes	Yes	No	No
2252	100 MHz	4	Dual	Yes	Yes	Yes	Yes	Yes	Yes	Yes



Make difficult measurements faster and more accurately. Rise time measurements are made automatically with the integrated 200 MHz counter/timer on the 2247A and 2252.

DIGITAL VOLTMETER BUILT-IN

The voltmeter measurement system simplifies measurements of + peak, – peak, peak-to-peak, DC and gated volts, all with convenient on-screen readout of values. Tektronix' unique SmartCursors™ make interpretation even easier. They automatically track changes in voltmeter measurements and visually indicate where ground and trigger levels are located. The built-in voltmeter along with Smart Cursors™ delivers instant answers.

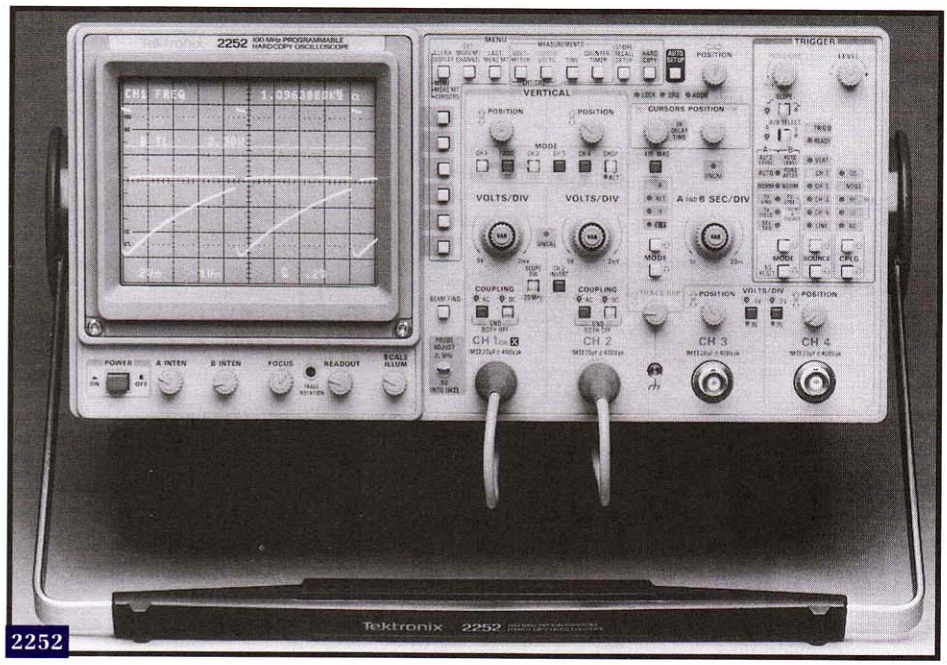
INTEGRATED PRECISION TIMER/COUNTER

The 200 MHz counter/timer delivers crystal-controlled accuracy for your timing measurements. You can measure frequency, width, period, and totalized events directly from your input channels. Rise and fall time can be made automatically at predefined thresholds (10-90%, 20-80%) or user-set reference levels. Propagation delay measurements between channels are push-button simple. And all measurements can be made using gated time intervals simply by adjusting an intensified zone to any size and position on your waveform.

HARDCOPY DOCUMENTATION

With the introduction of the 2252, Tektronix combines the precision and versatility of analog real-time with the power of waveform digitizing. At the push of a button, repetitive waveforms are quickly digitized using a proprietary sequential sampling technique. With this innovation, an Epson-compatible printer replaces the traditional CRT camera for waveform documentation. Each channel is acquired using 500-point record length and up to 12-bit vertical resolution, then transferred via the Centronics interface to your printer. Active measurements and scale factors are also documented. An exclusive peak detection process further ensures anti-aliasing, and is capable of detecting repetitive events as narrow as 10 ns at any sweep speed.

Continued on next page.

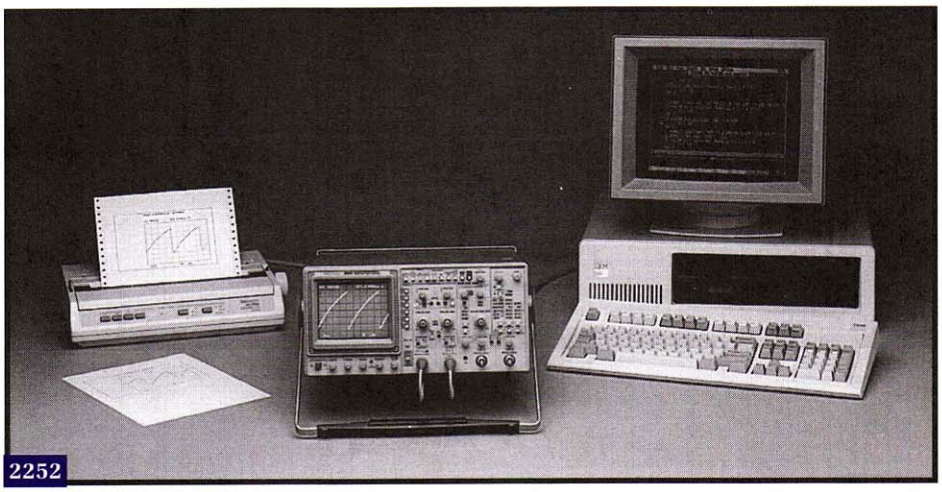


2252

Dual Time Base Oscilloscopes

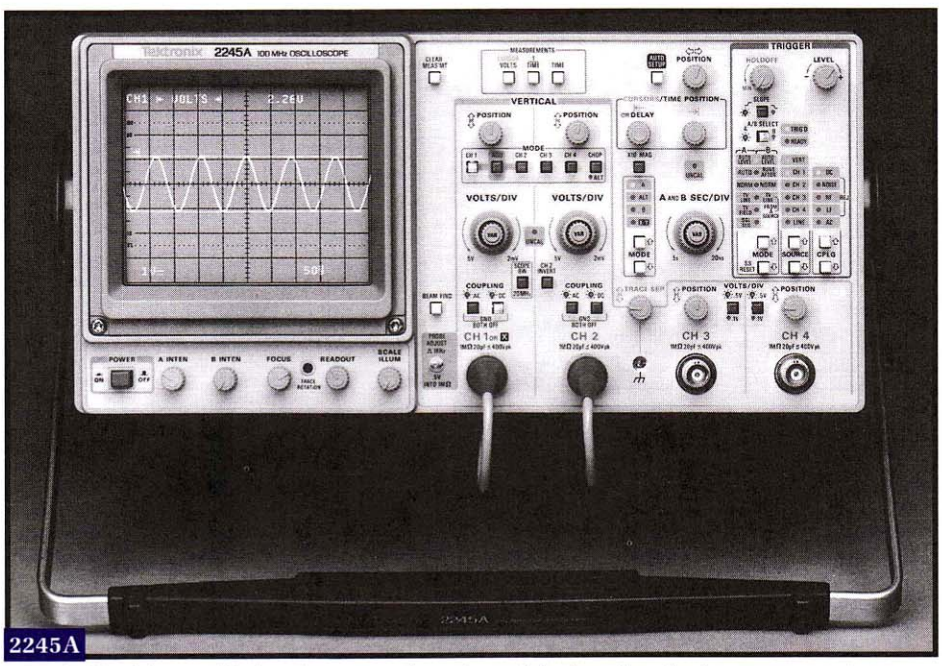
100 MHz

2245A
2247A
2252



2252

2252: The only oscilloscope that combines the versatility of analog display with the power of precision measurement tools, full programmability and push-button waveform hardcopy. Ideal for manufacturing test, depot repair, service documentation, and bench-top ATE.



2245A

2245A: Ideal for troubleshooting, general repair, and design where basic measurements are often needed. Time and voltage cursors make short work of signal time and amplitude analysis.

FULL GPIB PROGRAMMABILITY

The 2252 extends its power of automation to include full programmability of all front panel and menu controls. The standard GPIB (IEEE 488.2) interface allows access to all scope functions, including instrument setup, signal acquisition, and measurement control. Digitized waveforms can be acquired and transferred to a personal computer for analysis, documentation, and archiving. Measurements can be queried, and test routines easily created for go/no-go testing.

The 2252 is as easy to program as it is to use. In addition to specific command variables, the operator can learn an entire front-panel setting simply be querying the current instrument setup. The response can be stored in a file, then downloaded to the scope when needed at a later time. To support automated test development, a 2252 instrument driver is also available for Tektronix' popular EZ-Test PC software program. See the Test and Measurement Software section of this catalog for more information on this complete development and test routine software system.

UNMATCHED PERFORMANCE AND INNOVATION

The 2245A, 2247A, and 2252 are packed with performance capabilities and innovation to meet your automation needs. Whether you're looking for automation in the field, on the design bench, or an entire production line, these scopes can meet the challenge.

Continued on next page.

2245A
2247A
2252

Dual Time Base Oscilloscopes

100 MHz

Characteristics

Characteristics are common to the 2252, 2247A, and 2245A except where noted.

VERTICAL SYSTEM (4 CHANNELS)

Bandwidth (–3 dB) and Rise Time – 100 MHz and 3.5 ns (–10°C to + 35°C); 90 MHz and 3.9 ns (2 mV/div or + 35°C to + 55°C). Bandwidth limit: 20 MHz.

Deflection Factor and Accuracy – CH 1 & 2: 2 mV/div to 5 V/div; CH 3 & 4: 0.1 V/div and 0.5 V/div; all at ±2% (±3% outside +15°C to + 35°C). CH 1 & 2 variable at least 2.5:1.

Vertical Operating Modes – CH 1, 2, 3, 4, CH 2 IN-VERT, ADD, ALT, CHOP (625 kHz).

CMRR – At least 10:1 at 50 MHz.

Input R and C – 1 MΩ, 20 pF.

Max Input Voltage – 400 V (DC + peak AC) or 800 Vp-p.

Channel Isolation – 50:1 at 100 MHz.

HORIZONTAL SYSTEM

Sweep Speeds – A Time Base: 0.5 s/div to 20 ns/div; B Time Base: 5 ms/div to 20 ns/div (X10 MAG to 2 ns/div).

Accuracy – ±2%; Magnified ±3% (degrade by 1% outside +15°C to + 35°C).

Horizontal Operating Modes – A, ALT, B, X-Y.

Delay Jitter – 20,000:1.

Delay Accuracy – ±0.5% + 5% of one div + 25 ns.

TRIGGER SYSTEM

Trigger Sensitivity (A and B) – DC: 0.35 div to 25 MHz, 1.0 div at 150 MHz. Noise Reject: 1.4 div to 25 MHz, 2.2 div at 100 MHz. HF Reject: attenuates above 70 kHz. LF Reject: attenuates below 50 kHz. AC: Same as DC, attenuates below 25 Hz. TV Line, TV Field: 0.5 div of composite sync for stable display.

Trigger Operating Modes – A mode: AUTO LEVEL, AUTO, NORM, TV LINE, TV FIELD, SINGLE SEQ. B mode: RUNS AFTER DELAY, AUTO LEVEL, NORM, TV LINE (from A source).

Trigger Source (A and B) – VERT, CH 1, 2, 3, 4, LINE.

Variable Holdoff – At least 10:1.

X-Y OPERATION

Deflection Factors – Same as vertical system.

X-Y Operating Modes – X: CH 1; Y: CH 1, 2, 3, 4, and ADD.

Bandwidth – X-Axis: 3 MHz; Y-Axis: 100 MHz.

Phase Difference – ±3° from DC to 50 kHz.

CRT SYSTEM

Display – 8 cm x 10 cm, 16.5 kV nominal voltage.

Z-Axis – 3.8 V causes noticeable modulation. Usable to 10 MHz.

POWER REQUIREMENTS

Line Voltage Range – 90 VAC to 250 VAC.

Line Frequency – 48 Hz to 445 Hz.

Maximum Power Consumption – 100 W (155 VA).

ADVANCED FUNCTIONS

Cursors – Time, 1/Time: ±0.5% + 2% of one div; Delta Time, 1/Delta Time, Delta Phase (2247A/2252): ±0.5% +1% of one div; Volts: ±0.5% + 2% of one vertical div.

Voltmeter (2252 and 2247A) – DC Volts: ±(0.5% of reading + 2% of one vertical div + 250 µV); Plus or Minus Peak Volts: ±(2% of reading + 10% of one div + 1.0 mV) and Pk-Pk Volts (25 Hz to 25 MHz): ±(2% of reading + 15% of one div + 1.5 mV). Channels 1 and 2.

Counter/Timer (2252 and 2247A) – Time Base and Accuracy: 200 MHz and 10 ppm (0.001%). Frequency: 0.01 Hz to 100 MHz. Max resolution: 0.00000001 Hz. Max accuracy same as time base. Period: 100 s to 5 ns. Max resolution: 0.1 fs. Max accuracy same as time base. Width: 100 s to 5 ns. Max resolution: 1 ps. Max accuracy same as time base ±2 ns. Totalize: 100,000,000 counts. Delta Time: 0 to 5 s. Max resolution: 1 ps. Max accuracy same as time base ±100 ps. 1/Delta Time: 0.2 Hz to 10 GHz. Rise/Fall: 0 to 5 s. Max resolution: 1 ps. Max accuracy same as time base ±2 ns. Propagation Delay: 0 to 5 s. Max resolution: 1 ps. Max accuracy same as time base ±100 ps. External C/T Timebase Input: 10.1 kΩ AC coupled. Sensitivity: 1 Vp-p. Max input V: 35 VDC + peak AC. Frequencies: 1, 5, and 10 MHz.

Centronics Interface (2252) – Printers: Epson FX-Series (9 or 24 pin).

ANSI/IEEE-488.2 GPIB Interface (2252) – Function Subsets: SH1, AH1, T6, L4, SR1, RL1, DC1, DT, PPO, E1, and CO.

DIGITIZER SYSTEM (2252)

Type – Sequential (10 ns peak detection).

Resolution – Vertical: 12 Bits (250 levels/div) (25 pts/div for hardcopies). Horizontal: 9 Bits (50 pts/div).

Record length – 500 points per channel (four channels).

Useable Sweep Speeds – (A Horizontal Mode only) 0.5 s to 20 ns/div.

INSTRUMENT OPTIONS

Channel 2 And A-Gate Output (Opt. 15) – Channel 2 Output – Bandwidth: DC to 25 MHz; Deflection factor: 10 mV/div into 50 Ω, 20 mV/div into 1 MΩ; Dynamic Range: ±7 divisions; DC Offset: < 0.5 divisions. A-Gate Output Level – TTL compatible; Drive: 4 mA (high state), 20 mA (low state).

ENVIRONMENTAL SPECIFICATIONS

Instruments meet in part, the environmental requirements of MIL-T-28800D or C for Type III, Class 3, Style D or C equipment as described below.

Ambient Temp – Operating: –10°C to +55°C. Nonoperating: –51°C to +71°C.

Humidity – Percent: 95% 5 cycles, (120 hours). Reference: MIL-T-28800D, paragraph 4.5.5.1.2.2.

Altitude – Operating: to 4,500 m (15,000 ft.), maximum operating temp decreases 1°C per 300 m above 1500 m. Nonoperating: to 15,000 m (50,000 ft.).

EMC – Meets Class B requirements per VDE 0871-B for radiated and conducted emissions and FCC requirements.

Vibration – Operating: 15 minutes along each of the 3 major axis, 10 Hz to 55 Hz to 10 Hz in one minute cycles. Hold for 10 minutes at 55 Hz. Displ. (in p-p) 0.025.

Shock – Operating: 30 g, 1/2 sine, 11ms duration, 3 shocks per axis along each major axis. Total of 18 shocks.

OTHER CHARACTERISTICS

Safety – UL 1244 listed, CSA certification.

Warranty – 3 years.

PHYSICAL CHARACTERISTICS

Dimensions	mm	in.
Height	164	6.4
Width (with handle)	362	14.2
Depth (with front cover)	445	17.5
Weight	**kg**	**lb.**
Net	8.7	17.9

Dual Time Base Oscilloscopes

100 MHz

2245A
2247A
2252

ORDERING INFORMATION

2252
100 MHz Programmable Oscilloscope with Hardcopy Output ..... TD **$3,995**
Includes: Two 10X Voltage Probes (P6109B), Operators Manual (070-7837-00), Users Reference Guide (070-7839-00), 3 Year Warranty, Power Cord.

2247A
100 MHz Oscilloscope with Voltmeter/Counter/Timer ..... TD **$3,495**
Includes: Two 10X Voltage Probes (P6109B), Operators Manual (070-6373-00), Users Reference Guide (070-6688-00), 3 Year Warranty, Power Cord.

2245A
100 MHz Oscilloscope with Cursors ..... TD **$2,595**
Includes: Two 10X Voltage Probes (P6109B), Operators Manual (070-6558-00), Users Reference Guide (070-6718-00), 3 Year Warranty, Power Cord.

Opt. 1R – Rackmounted Instr. ..... **+$350**
Opt. 15 – CH 2 & A Gate Output ..... **+$100**
Opt. 22 – Add two P6109B probes ..... **+$140**
Opt. 23 – Add two P6129B 1X/10X probes ..... **+$190**

INTERNATIONAL POWER PLUG OPTIONS
Opt. A1 – Universal Euro 220 V, 50 Hz. Order 020-0859-00 ..... **NC**
Opt. A2 – United Kingdom 240 V, 50 Hz. Order 020-0860-00 ..... **NC**
Opt. A3 – Australian 240 V, 50 Hz. Order 020-0861-00 ..... **NC**
Opt. A4 – North American 240 V, 50 Hz. Order 020-0862-00 ..... **NC**
Opt. A5 – Switzerland 220 V, 50 Hz. Order 020-0863-00 ..... **NC**
See Customer Information Section for additional description.

WARRANTY-PLUS SERVICE OPTIONS
Opt. M2 – Repair Protection
2252 ..... **+$210**
2247A ..... **+$180**
2245A ..... **+$140**

Opt. M8 – Calibration Service
2252 ..... **+$210**
2247A ..... **+$180**
2245A ..... **+$140**

PROBES
See Page 423 for complete description and full line of probes.

Passive Voltage –
10 MHz/100 MHz, 1X/10X, switchable, with readout.
Order P6129B **$95**
100 MHz, 10X, ruggedized, w/readout. Order P6109B **$70**
15 MHz, 1X, modular w/o readout. Order P6101B **$60**

Current –
20 Amp max, DC to 50 MHz, w/A6302 current probe.
Order AM503S **$2,595**
100 Amp max, DC to 15 MHz, w/A6303 current probe
Order AM503S Opt. 03 ..... **$3,240**

High Voltage – 1.5 kV 100X, 120 MHz with readout.
Order P6009 ..... **$265**
40 kV 1000X, 75 MHz with readout. Order P6015A Opt. 1R **$950**

Differential – 100 MHz, 1X/10X differential probe, FET.
Order P6046 w/pwr **$2,195**

Temperature Probe – 230°C max (2236A only).
Order P6602 ..... **$335**

Logic probe – 16 channel word recognizer/Trigger-TTL.
Order P6408 ..... **$425**

Cable – Centronics 2252 to printer (25 pin).
Order 012-1250-00 ..... **$50**

CART – Portable instrument. Order K212 ..... **$395**

CAMERA – Scopes with graticule illum.
No flash required on camera. Order C-9 Opt. 20 ..... **$510**

Digital Timing Demodulator – Order TVC501 ..... **$2,500**

ADDITIONAL ACCESSORIES
Carrying Strap – Order 346-0199-00 ..... **$22**
Transit Carrying Case – Order 016-0792-01 ..... **$380**
Front Panel Cover – Order 200-3232-00 ..... **$11.75**
Accessory Pouch – Order 016-0857-00 ..... **$50**
Rain Cover – Order 016-0848-00 ..... **$22**

Service Manuals –
2252. Order 070-7838-00 ..... **$105**
2247A. Order 070-6367-00 ..... **$95**
2245A. Order 070-6557-00 ..... **$105**

Rackmount Kit – Order 2240F1R **$350**
QuickStart Training Package – Order 020-1864-04*[1] **$199**
DC Power – Battery Pack. Order 1106 ..... **$3,495**
12 VDC to 110 VAC Inverter. Order 1107 ..... **$1,995**

Viewing Hoods –
Collapsible. Order 016-0592-00 ..... **$16.50**
Binocular. Order 016-0566-00 ..... **$24**
Polarized. Order 016-0180-00 ..... **$315**

CRT Shields –
Blue. Order 337-2775-00 ..... **$5.00**
Clear. Order 337-2775-01 ..... **$2.40**

*[1] *See pages 391-394 for additional educational information.*

TD
Call Direct – Product available within 24 hours, (through TekDirect only). Call 1-800-426-2200. Also available through an Authorized Tektronix Distributor (listed on page 540).

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

GPIB IEEE-488 — The 2252 complies with IEEE Standard 488.2-1988, and with Tektronix Standard Codes and Formats.

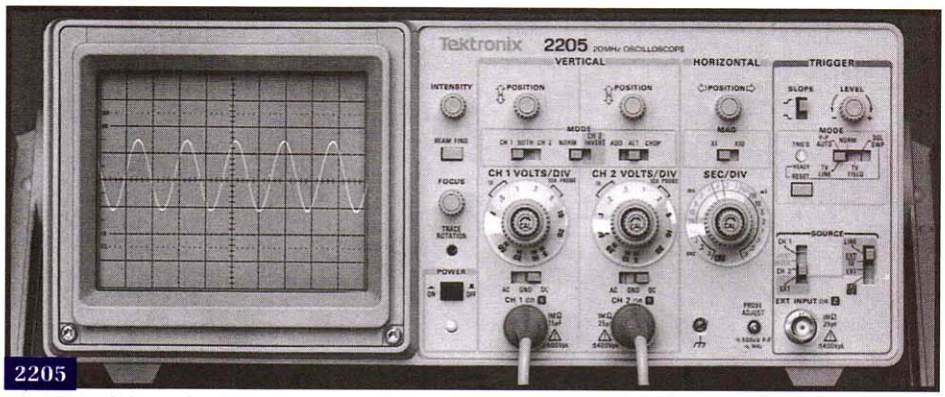
Portable Analog Oscilloscopes

20 MHz

Everything you need for basic scope measurements to 20 MHz.

2205

- Peak-to-Peak Auto Triggering
- 0.3 div Trigger Sensitivity
- Front Panel Z-Axis Input
- 10 ns/div Max. Sweep Rate



The 2205 delivers basic analog scope functions in a rugged affordable package. Configure it with other low-cost Tektronix bench equipment, and you have the perfect combination for field applications, classroom labs, or production test.

2205 Oscilloscope

SOLID PERFORMANCE AND TEKTRONIX QUALITY

The 20 MHz, two channel 2205 is the most basic of the 2200 Series analog scopes, yet it offers Tektronix quality and unexpected performance features. Engineered for ease of operation, versatility, and ruggedness, the 2205 provides solid performance and a price that's right for a variety of applications.

Unlike other scopes in this range you don't have to give up signal quality, trigger stability, or accuracy when using the full bandwidth of the instrument. This is a true 20 MHz oscilloscope.

With its industrial quality construction and ability to operate under environmental extremes, the 2205 is an excellent choice for field applications, production testing, or classroom instruction.

VALUE-ADDED FEATURES

In the 2205, performance features add value, not expense. For example, standard features include 5 mV/div vertical sensitivity, a fast 10 ns/div horizontal display and a flexible trigger system. Peak-to-peak auto capabilities deliver virtually hands-free triggering. Also featured are TV line and field triggering and front-panel access to the Z-axis input.

IDEAL FOR TEST SYSTEMS

The 2205 can be configured with low-cost bench equipment available from Tektronix (See pages 370-390 for TM 250 products). These configurations are ideal for use in applications such as field service, production testing and classroom lab stations.

Characteristics

VERTICAL SYSTEM (2 IDENTICAL CHANNELS)

Bandwidth (–3 dB) and Rise Time – 20 MHz and 17.5 ns (5°C to 35°C). 15 MHz and 23.3 ns (0°C to 40°C).

Deflection Factor and Accuracy – 5 mV/div to 5 V/div ±3%, (15°C to 35°C); ±5%, (0°C to 40°C).

Vertical Operating Modes – CH 1, CH 2, CH 2 IN-VERT, ADD, ALT, CHOP.

CMRR – At least 10:1 at 10 MHz.

Input R and C – 1 MΩ, 25 pF.

Max Input Voltage – 400 V (DC + peak AC), 800 Vp-p.

Channel Isolation – 100:1 at 20 MHz.

HORIZONTAL SYSTEM

Sweep Speeds – 0.5 s/div to 0.1μs/div. (X10 MAG to 10 ns/div).

Accuracy – ±3%; Magnified ±4% (degrade by 1% outside 15°C to 35°C).

Horizontal Operating Modes – X1, X10, X-Y.

TRIGGER SYSTEM

Trigger Sensitivity – Internal: 0.30 div at 5 MHz, 1.0 div at 30 MHz. External: 40 mV at 5 MHz, 150 mV at 30 MHz.

Trigger Operating Modes – Peak-Peak AUTO, NORM, TV FIELD, TV LINE, SGL SWP.

Trigger Source – VERT MODE, CH 1, CH 2, LINE, EXT, EXT/10.

Trigger Coupling – AC, DC.

X-Y OPERATION

Deflection Factors – Same as vertical system.

Bandwidth – X-Axis: 2 MHz. Y-Axis: same as vertical system.

Phase Difference – ±3° from DC to 50 kHz.

TD

Call Direct – Product available within 24 hours, (through TekDirect only). Call 1-800-426-2200. Also available through an Authorized Tektronix Distributor (listed on page 540).

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

Portable Analog Oscilloscopes

20 MHz

CRT SYSTEM

Display – 8 cm x 10 cm, 1.8 kV nominal voltage.

Controls – INTENSITY, TRACE ROTATION, BEAM FIND, FOCUS.

Z-Axis – 5 V causes noticeable modulation. Useable to 5 MHz.

POWER REQUIREMENTS

Line Voltage Range – Low: 95 VAC to 128 VAC. High: 185 VAC to 250 VAC.

Line Frequency – 48 Hz to 440 Hz.

Maximum Power Consumption – 40 W (60 VA).

ENVIRONMENTAL SPECIFICATIONS

Instruments meet in part, the environmental requirements of MIL-T-28800D or C for Type III, Class 3, Style D or C equipment as described below.

Ambient Temp – Operating: 0°C to +40°C. Nonoperating: –55°C to +75°C.

Humidity – Percent: 95% 5 cycles, (120 hours) 90% +40C 4 hours. Reference: MIL-T-28800D, paragraph 4.5.5.1.2.2. Tektronix 062-2847-00, II.

Altitude – Operating: to 4,500 m (15,000 ft.), maximum operating temp decreases 1°C per 300 m above 1500 m. Nonoperating: to 15,000 m (50,000 ft.).

EMC – Meets Class B requirements per VDE 0871-B for radiated and conducted emissions and FCC requirements.

Vibration – Operating: 15 minutes along each of the 3 major axis, 10 Hz to 55 Hz to 10 Hz in one minute cycles. Hold for 10 minutes at 55 Hz. Displ. (in p-p): 0.015.

Shock – Operating: 30 g, 1/2 sine, 11ms duration, 3 shocks per axis along each major axis. Total of 18 shocks.

OTHER CHARACTERISTICS

Safety – UL 1244 listed, CSA certification.

Warranty – 1 year; 3 years optional.

PHYSICAL CHARACTERISTICS

Dimensions	mm	in
Width (with handle)	380	15.0
Height	137	5.4
Depth (without front cover)	440	17.3
Weight	**kg**	**lb**
Net	6.7	14.8

ORDERING INFORMATION

2205

20 MHz Oscilloscope ..... TD **$695**

Includes: Two 1X test leads (103-0275-00), Operators Manual (070-6717-00), 1 Year Warranty, Power Cord.

Opt. 22 – Add 24 test leads ..... **+$60**

Opt. 23 – Add 2 P6119 1X/10X Probes ..... **+$150**

Opt. 24 – Add 2 P6103 10X Probes ..... **+$100**

INTERNATIONAL POWER PLUG OPTIONS

Opt. A1 – Universal Euro 220 V, 50 Hz. Order 020-0859-00 ..... **NC**

Opt. A2 – United Kingdom 240 V, 50 Hz. Order 020-0860-00 ..... **NC**

Opt. A3 – Australian 240 V, 50 Hz. Order 020-0861-00 ..... **NC**

Opt. A4 – North American 240 V, 50 Hz. Order 020-0862-00 ..... **NC**

Opt. A5 – Switzerland 220 V, 50 Hz. Order 020-0863-00 ..... **NC**

See Customer Information Section for additional description.

WARRANTY-PLUS SERVICE OPTIONS

Opt. M7 – Calibration Service ..... **+$35**

Opt. M9 – Repair Protection ..... **+$70**

PROBES

See Page 423 for complete descriptions.

Passive Voltage –

1X/10X, switchable, w/o readout. 10 MHz, 120 pF/1 MΩ, 2 m; 100 MHz, 15.3 pF/10 MΩ, 2 m. Order P6119B **$75**

60 MHz, 10X, ruggedized, w/o readout. 13.2 pF/10 MΩ, 2 m. Order P6103B **$40**

15 MHz, 1X, modular w/o readout. 54 pF/1 MΩ, 2 m. Order P6101B **$60**

Current –

20 Amp max, DC to 50 MHz, w/A6302 current probe. Order AM503S **$2,595**

100 Amp max, DC to 15 MHz, w/A6303 current probe. Order AM503S Opt. 03 ..... **$3,240**

High Voltage –

1.5 kV 100X, 120 MHz with readout. Order P6009 ..... **$265**

40 kV 1000X, 75 MHz with readout. Order P6015A Opt. 1R **$895**

Specialty –

100 MHz, 1X/10X differential probe, FET Order P6046 w/pwr **$2,195**

Logic probe, 16 channel word recognizer/Trigger-TTL Order P6408 ..... **$425**

Cameras – Order C-9 Opt. 20, Opt. 1F **$570**

Digital Timing Demodulator – Order TVC501 ..... **$2,495**

ADDITIONAL ACCESSORIES

Cart – Portable instrument. Order K212 ..... **$395**

Service Manual – Order 070-6716-00 ..... **$105**

Rackmount Kit – Order 016-0819-03 ..... **$275**

Self-Study Package Video*1 – Order 068-0289-xx **$60**

Carrying Strap – Order 346-0199-00 ..... **$22**

Transit Carrying Case – Order 200-3397-00 ..... **$18.50**

Front Panel Cover – Order 016-0677-02 ..... **$75**

DC Power –

Battery Pack. Order 1104A **$550**

Battery Pack. Order 1106 ..... **$3,495**

12 VDC to 110 VAC Inverter. Order 1107 ..... **$1,995**

Viewing Hoods –

Collapsible. Order 016-0592-00 ..... **$16.50**

Binocular. Order 016-0566-00 ..... **$24**

Polarized. Order 016-0180-00 ..... **$315**

CRT Shields –

Blue. Order 337-2775-00 ..... **$5.00**

Clear. Order 337-2775-01 ..... **$2.40**

*1 *See the Educational Section, pages 391-394 for more information.*

TD

Call Direct – Product available within 24 hours, (through TekDirect only). Call 1-800-426-2200. Also available through an Authorized Tektronix Distributor (listed on page 540).

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

Digitizers

SCD Family

The SCD Family of Transient Waveform Digitizers provide the unique capability of high time and amplitude resolution single-shot capture of low nanosecond and picosecond events. This technology allows a large number of waveform data points even on the fastest events.

RTD720A/RTD710A

The 720A provides high fidelity capture of transient events. This high fidelity is maintained without the need for post acquisition correction, enhancement, filtering or averaging of the acquired waveform data. This quality of the acquired signal translates directly to the effective resolution that the acquisition system provides.

The RTD710A provides high resolution, accuracy, and speed. With four times the resolution of an 8-bit digitizer and 60 dB of dynamic range, the RTD710A provides excellent resolution of fine signal details.

9503/9504

The 9503 or 9504 provide storage of long data records obtained from high speed analog-to-digital converter. In conjunction with the RTD710A Waveform Digitizer, they provide the fastest real-time data logging capability for multiple, complex waveforms.

Series 2000

The Analytek Series 2000 Waveform Capture System provides many acquisition channels in a compact and low cost package. The Series 2000 are an unmatched combination of high acquisition rates and input channel density with low power requirements. As the number of channels increase, the total cost per channel becomes significantly lower.

CONTENTS

DIGITIZERS

SCD 5000 4.5 GHz, Transient Event.....132
SCD 1000 1 GHz Transient Event.....132
RTD 720A Transient Waveform 135
RTD 710A Transient Event.....138
TD 1301 Digitizer and Viewing System...138
9504 Fast Data Cache 142
9503 Fast Data Cache 142
Analytek Series 2000 Waveform Capture System 144

SCD 5000
SCD 1000

Transient Event Digitizers
1 and 4.5 GHz Bandwidth

High performance transient event capture.

SCD FAMILY

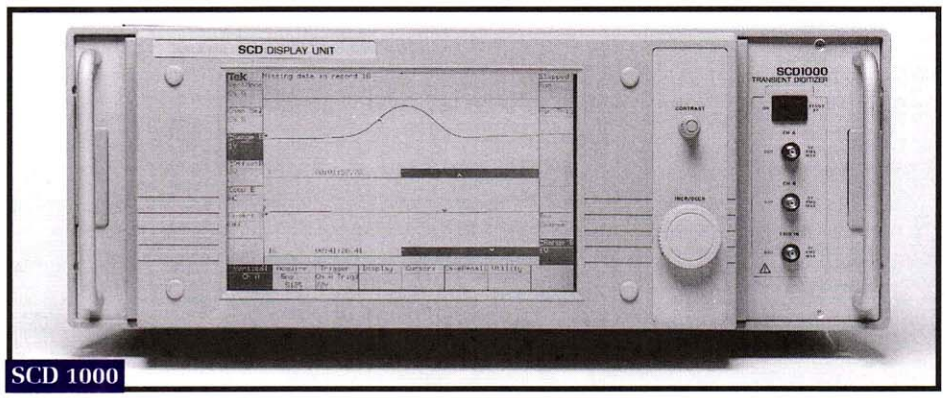
- High Single-Shot Sample Rate to 200 GS/s (5 psec/pt)
- High Analog Bandwidth

  4.5 GHz with SCD5000

  1.0 GHz with SCD1000
- 11-Bit Vertical Resolution (2048 levels of resolution)
- Variable Record Lengths 256, 512, 1024
- Display Unit for Easy Control, Viewing, and Measurements

SCD FAMILY APPLICATIONS

- Nuclear Events
- EMP and Radiation Simulators
- ESD (Electro-Static Discharge)
- Laser Induced Phenomena
- Pulsed Power Sources
- Analysis of Fast Pulsed Events
- High Energy Physics
- Fluorescence Decay
- Radar & Lidar
- High Frequency Ultrasonics



SCD 1000

SCD 5000/SCD 1000

The Tektronix SCD Family of Transient Waveform Digitizers provide the unique capability of high time and amplitude resolution single-shot capture of low nanosecond and picosecond events. For electrical signals the SCD Family provides the highest bandwidth and sample rates for transient event capture. Designed for the capture of very fast transition single-shot events this technology allows a large number of waveform data points even on the fastest events.

STAND-ALONE SUPPORT

The SCD Family, while designed as a system product, has a feature set and capabilities to meet application requirements as a stand-alone instrument. These include a display unit for waveform viewing that also provides for full instrument control. The display provides viewing of up to 4 waveforms with horizontal and vertical expansion for finer detail visual examination. Cursors, that can be placed on the same waveform or different waveforms, allow for absolute and delta time and amplitude values on any part of the waveform(s).

Further supporting this capability is a set of on-board time and amplitude measurements. These measurements routines also provide a high degree of flexibility for how measurements are made and over what part of the waveform the measurements are made. Up to 8 of the 21 measurements that are made can be displayed on the Display Unit (all 21 measurements plus additional information is available over the GPIB).

For benchtop use the SCD Family Display Unit provides waveform viewing and full instrument control. There is hardcopy capability using either a video copier or to a plotter using the GPIB. Hardcopies can be initiated from either the display unit or over the GPIB.

SYSTEM SUPPORT

The SCD Family is designed as a system product. Besides the hardware and firmware capabilities described above the SCD Family has additional features addressing system applications. These include:

- External Arming
- External Triggering
- Gate Out Signal effectively providing a trigger output
- 10 stored (and battery backed-up) instrument settings
- Rack mounting hardware a standard part of the instrument;
- As an option rear signal inputs and signal feed-through
- Display Unit that can be moved from instrument to instrument

These capabilities are further supported with an "Engineering English like" command set that eases the task of software development. The optional Display Unit also has a Debug mode that allows viewing of the GPIB traffic to the instrument with error and event condition reporting.

Another important system capability is the maintaining of the highest accuracy and signal fidelity. The SCD Family provides a Standardize function, instrument diagnostics, and power-on diagnostics (power-on diagnostics can be turned off by the user) to meet these requirements. The Standardize function (executing only upon user request either over the GPIB or from the Display Unit) is used to maintain the highest accuracy. Power-on and instrument diagnostics are used to verify the proper functioning and performance of the instrument.

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

GPIB IEEE-488 — The SCD5000/SCD1000 Series of Digitizers complies with the IEEE Standard 488.1 and Tektronix Standard Codes and Formats.

Transient Event Digitizers

1 to 4.5 GHz Bandwidth

SCD 5000
SCD 1000

HIGH FIDELITY WAVEFORM CAPTURE
The SCD Family provides high time and amplitude resolution capture of extremely fast transient events. Offering an unmatched combination of bandwidth and sample rate performance required for the capture of the fastest transient signals.

Characteristics

HORIZONTAL

Time per Point – 5 ps/pt (5 nsec time window with 1024 point record length) to 400 ns/pt (100 µsec time window with 256 point record length).

Time Windows – 5 nanoseconds to 100 microseconds in a 1-2-5 sequence.

Record Length – 256, 512, or 1024 waveform data points.

Trigger Delay – 0% to 900% of time window.

Multiple Records (Auto-Advance) – 16 waveform locations (first 4 locations are battery backed-up).

Time Stamping – Time and date are stored with each acquisition.

Arming – Internal or External. Triggers are not recognized unit the unit is armed. External Arm is a BNC input that arms on a switch closure to ground (internal pull-up provided to 5 V).

Gate Out Signal – A TTL low level (≤0.8 V) output at the BNC for the duration of the sweep.

VERTICAL (Cont.)

Input Channel – Each SCD provides a single channel of transient event waveform digitizing. The SCD1000 provides two independent signal conditioning inputs channels that can be used as either or the other or added together.

Parameter	SCD5000	SCD5000 Opt. 01	SCD1000
Analog Bandwidth (–3 dB)	≥4.5 GHz	≥3.0 GHz	≥1.0 GHz
Risetime (from Calculation) Tr = 0.35/Bandwidth	≤80 picoseconds	≤120 picoseconds	≤350 picoseconds
Vertical Resolution Averaging	11 bits / 2048 levels Averaging to 14 bits	11 bits / 2048 levels Averaging to 14 bits	11 bits / 2048 levelsl Averaging to 14 bits
Input Range(s) Resolution per Bit	5 V Full Scale 2.44 mV / bit	10 V Full Scale 4.88 mV / bit	100 mV to 10 V Full Scale 1, 2, 5 Sequence
Offset Range	±4 V	±8 V	±2.5 X Input Range
Input Impedance and Coupling	DC Coupled: 50 Ω	DC Coupled: 50 Ω	DC Coupled: 50 Ω AC Coupled: 50 Ω in series with ≈ 2.2 µF
TRIGGERING			
Sources	External	External or Internal	External or Internal (CHA or CHB)
Coupling	AC	AC	AC or DC
Slope	Positive or Negative	Positive or Negative	Positive or Negative
Range	±0.5 V	±0.5 V External ±1.0 V Internal	±1.25 V External ±125% of Input Range Internal
Sensitivity (Sinewave) Internal	Not Applicable	500 mV 20 KHz to 50 MHz 1.5 V 50 MHz to 500 MHz 3.5 V 500 MHz to 1 GHz	5% of input range DC to 250 MHz 15% of input range 250 MHz to 1 GHz
Sensitivity (Sinewave) External	50 mV 20 KHz to 50 MHz 150 mV 50 MHz to 500 MHz 350 mV 500 MHz to 1 GHz	50 mV 20 KHz to 50 MHz 150 mV 50 MHz to 500 MHz 350 mV 500 MHz to 1 GHz	50 mV 20 KHz to 50 MHz 150 mV 50 MHz to 500 MHz 350 mV 500 MHz to 1 GHz
Sensitivity (Pulse) External	≤150 mV with 500 picosecond HAD (half duration amplitude) pulse	≤150 mV with 500 picosecond HAD (half duration amplitude) pulse	≤150 mV with 500 picosecond HAD (half duration amplitude) pulse
Pretrigger View Time	Not Applicable	≥2 nanoseconds	≥2 nanoseconds

SCD 5000
SCD 1000

Transient Event Digitizers
1 to 4.5 GHz Bandwidth

COMPUTER INTERFACES

GPIB - IEEE-488 – Interface is standard for instrument control and waveform data transfer. Maximum transfer rate ≥500 Kbytes/sec.

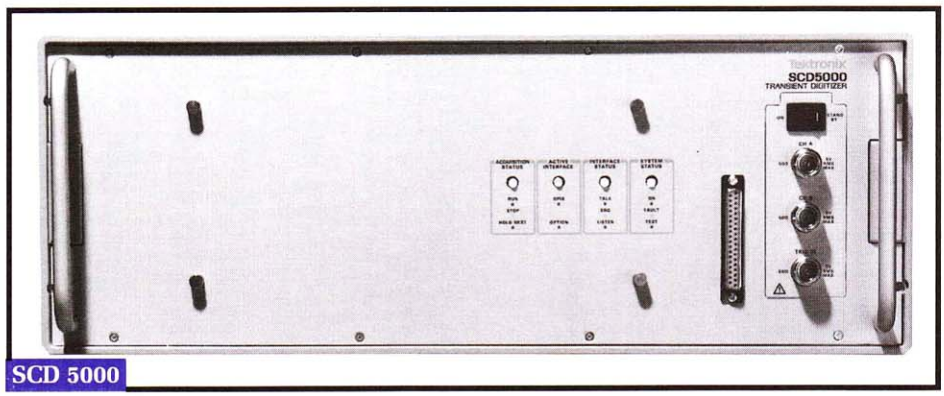
Parallel Port – As an (Opt. 2F) a waveform data output only 16-bit wide parallel port is provided capable of 2 Mwords (4 Mbytes) data transfer rates. This provides TTL level outputs and has several operating modes to allow use with a wide range of computer interface cards.

Calibrator Output – BNC providing the time and amplitude signals required for the Auto-Cal function. This can also be used to verify the performance of the internal Auto-Cal signals.

DISPLAY & INSTRUMENT CONTROL

Display – Provides for waveform viewing and instrument control. The waveform data display provides viewing of up to 4 waveforms at one time; with cursor measurement capability; and waveform display expansion in both time and amplitude. The waveform expansion capability enables viewing of the full waveform or zooming in for closer examination of details of interest. User selection of up to 8 of the 21 on-board time and amplitude measurements can also be displayed.

Hardcopy – The instrument also supports a video hardcopy capability (EGA compatible) and with the Display Unit plotter output over the GPIB is available without the need for a controller/computer. Using either hardcopy method a representation of the information on the Display Unit is provided. The EGA compatible output can also be used to drive an EGA compatible monitor.



SCD 5000

ENVIRONMENTAL (WITHOUT DISPLAY UNIT)

Temperature Range – Operating 0°C to 50°C.

Humidity – 0% to 95% relative humidity (non-condensing).

Altitude – Operating to 4.5 km (15,000 ft) maximum; Non-operating to 15 km (50,000 ft) maximum.

POWER REQUIREMENTS

Line Frequency – 48 to 440 Hz.

Voltage Range – Selected by rear panel switch 90 to 132 VRMS or 180 to 250 VRMS.

Power Consumption – SCD5000 and SCD1000 fully optioned ≤300 Watts.

Warranty – The SCD1000 and SCD5000 carries a standard Tektronix one-year warranty covering labor and replacement parts for the instrument.

ORDERING INFORMATION

SCD5000
4.5 GHz Bandwidth Transient Event Digitizer **$46,900**
Includes: Instrument with type N connectors and detachable display with power cord; fuses; User's Manual (070-6960-01); Instrument Interfacing Guide (070-7315-01); Quick Reference Guide (070-7316-01); and rack mount kit.

SCD1000
1.0 GHz Bandwidth Transient Event Digitizer **$29,900**
Includes: Instrument with type N connectors and detachable display with power cord; fuses, User's Manual (070-6960-01); Instrument Interfacing Guide (070-7315-01); Quick Reference Guide (070-7316-01); and rack mount kit.

Opt. 1P – Increase waveform capture and transfer rate from one to ten 512 point waveforms per second ..... **+$3,000**

Opt. 2E – Change Type N input connectors to SMA ..... **+$250**

Opt. 2F – Parallel Waveform Data Output Port with Battery Back-up of Linear Array Data ..... **+$3,500**

Opt. 20 – Delete Display Unit ..... **–$2,000**

Opt. 1E – (SCD1000 ONLY) Change Type N input connectors to BNC with Tektronix SmartProbe Interface ..... **+$900**

Opt. 01 – (SCD5000 ONLY) Add delay line with internal trigger pick-off ..... **+$3,000**

Opt. 9E – (SCD5000 ONLY) Change position of the input connectors to rear of the instrument (Type N connectors only) with signal feed-through and external termination (mutually exclusive with Options 01 and 2E) ..... **–$1,000**

INTERNATIONAL POWER PLUG OPTIONS

Opt. A1 – Universal Euro 220 V, 50 Hz ..... **NC**

Opt. A2 – United Kingdom 240 V, 50 Hz ..... **NC**

Opt. A3 – Australian 240 V, 50 Hz ..... **NC**

Opt. A4 – North American 240 V, 60 Hz ..... **NC**

Opt. A5 – Switzerland 220 V, 50 Hz ..... **NC**

PROBES

See Probe Section on Page 423 for additional description.

Active – 4 GHz, 0.4 pF/100 kΩ, 1 m.
(Requires Opt. 1E or 1103 Power Supply). Order P6217 ..... **$3,495**

50 Ω Divider – 50 Ω inputs. Divider probe set includes both of the following: 3.5 GHz, 1 pF/500 Ω; 3 GHz, 1 pF/5000 Ω, 1.5 m. Order P6156 with Opt. 25 ..... **$325**

Spring Contact – 300 MHz, 3.8 pF/1 MΩ, 2 ft.
(Requires Opt. 1E or 1103 Power Supply). Order P6511A **$300**

ADDITIONAL ACCESSORIES

Plotter – Four color. Order HC100 with Opt. 01 ..... **$1,180**

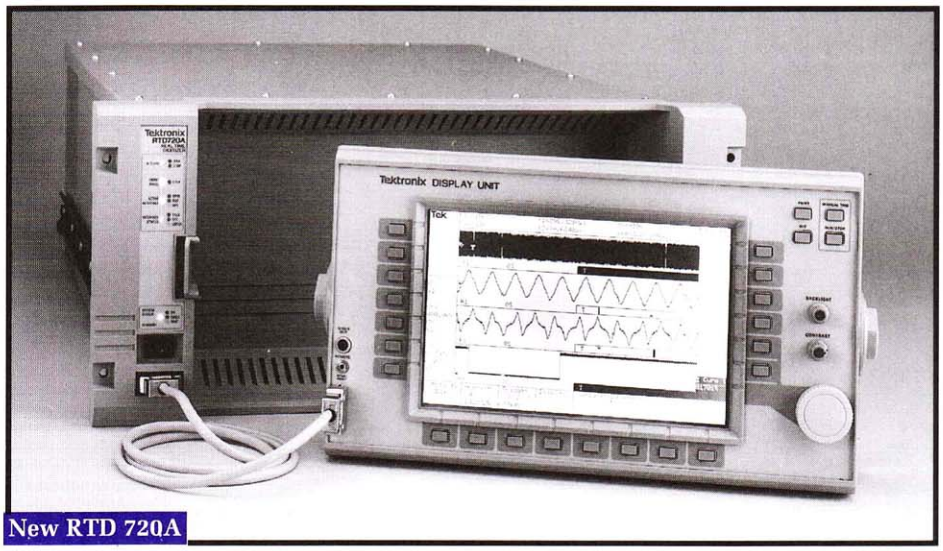
Video – Order HC02A **$3,100**

TEKPROBE – Power Supply. Order 1103 ..... **$495**

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

GPIB IEEE-488 — The SCD5000/SCD1000 Series of Digitizers complies with the IEEE Standard 488.1 and Tektronix Standard Codes and Formats.

Transient Waveform Digitizers



New RTD 720A

Signal Fidelity

The Tektronix RTD 720A Transient Waveform Digitizer provides high fidelity capture of transient events. Signal fidelity is another name for high resolution capture of signals. Base resolution is of little value if the characteristics of the signal are lost. The RTD 720A provides input signal conditioning and Analog to Digital conversion that maintains the characteristics of the signal of interest. Factors effecting signal quality include bandwidth, transient response, accuracy, input range and offset, overdrive recovery, and a measure of the complete digitizing process (i.e., IEEE-1057) Effective Bits measurement. The RTD 720A maintains the high fidelity required without the need for post acquisition correction, enhancement, filtering, or averaging of the acquired waveform data. This quality of the acquired signal translates directly to the effective resolution that the acquisition system provides.

The digitizing process and the quality of the waveform data provided is the starting point for high resolution and fidelity capture of transient events. Sample rate is another key parameter, since it determines the maximum signal frequency that can be accurately captured. The RTD 720A provides sample rates from 2 GS/s (500 picoseconds/point) to 5 MS/s (200 microseconds/point) for fine time resolution and accurate capture of the signals of interest. With up to four channels of acquisition (requires option 06) the RTD 720A provides high amplitude and time resolution and fidelity signal capture of multiple events. The long record length capability of the RTD 720A provides the needed final characteristic for high resolution and fidelity capture of transient events.

Long Acquisition Memory with Intelligent Utilization of the Memory

The waveform memory of the RTD 720A allows capture of even long duration events at the sample rate needed to accurately represent the signal to be captured. The RTD 720A's standard acquisition memory is 128K waveform data points (131,072 sample or >65 µsec time window at 2 GS/s). Optional acquisition memory is available for the RTD 720A of 512K of battery backed-up memory, 1M of memory, and 4M of memory. Memory can be assigned entirely to one channel or shared equally among the active channels (1, 2, or 4) with simultaneous acquisition on all channels.

Not only does the RTD 720A provide long memory for contiguous acquisition of waveforms, it also provides flexibility in memory usage. Memory can be configured for shorter acquisitions to match the total time of the event of interest. Further with shorter record length acquisitions memory can be partitioned to capture multiple independent events. Using the internal acquisition memory partitioned for the capture of many independent events provides a rapid signal capture capability. Auto-advance mode capture a sequence of up to 1024 events on each channel with only 5 µs rearm time between events. Time-of-Arrival of each event is also captured with time resolution as fine as 500 ps.

Further extending the usefulness of the memory is pre-trigger and post-trigger acquisition. With pre-trigger to approximately 100% of the record, it is possible to capture event prior to the triggering event. Post-triggering, to 99,999,999 sample intervals, allows capturing events occurring significantly after the trigger event. Flexibility in choosing the amount of pre-trigger or post trigger coupled with user selection of record length allows positioning of the acquisition over the event of interest.

Continued on next page.

RTD 720A APPLICATIONS

Impulse Phenomena

- Nuclear Events
- EMP and Radiation Simulators
- Laser Induced Phenomena
- Pulsed Power Sources
- Analysis of Multiple Fast Pulsed Events
- High Energy Physics

Pulse Echo Events

- Radar & Lidar
- High Frequency Ultrasonics

Long Record Length Applications

- Intelligence/ Electronic Warfare
- Spectroscopy (Time-of-Flight)
- Computer Mass Storage Device and Media Characterization

RTD 720A FEATURES

- 2 GS/s Single Channel Mode
- 1 GS/s Dual Channel Mode
- 500 MS/s Four Channel Mode
- Long Waveform Memory-128K Standard
  - 512K Battery Backed-up Memory Opt.
  - 1M Memory Opt.
  - 4M Memory Opt.
- Intelligent Memory Usage
  - User Selection of Memory Size
  - Extremely Fast Multiple Event Capture
- 500 MHz Analog Bandwidth
- 8-Bit Vertical Resolution
- Optional Removable Display with Remote Operation Capability

High fidelity capture of transient events.

TD

Product also available through an Authorized Tektronix Distributor (listed on page 540).

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

GPIB IEEE-488

The RTD 720A complies with the IEEE Standard 488.1, and with Tektronix Standard Codes and Formats.

Transient Waveform Digitizers

High Speed Waveform Data Transfers

Complementing the high capture rate of the RTD 720A, a fast and efficient data transfer capability is provided by both hardware and instrument firmware. The RTD 720A is designed to transfer data to a computer very rapidly.

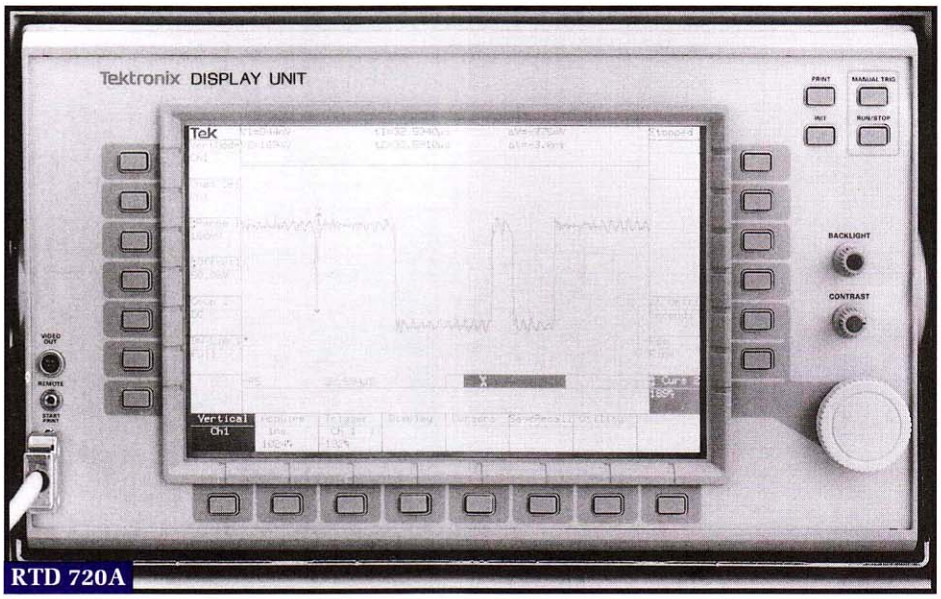
The digitizer's GPIB (IEEE-488) computer interface provides efficient instrument control and waveform data transfer. In burst mode (such as when transferring waveform data) the maximum transfer rate is ≥500 Kbytes per second (dependent on the transfer speed capability of the computer). For even faster transfer of waveform data a 16-bit parallel port is provided that is capable of transferring 4 Mbytes per second (2 Mwords per second). The parallel port operates with TTL levels supporting both a handshaked and clocked mode of operation.

To take advantage of the hardware speed the RTD 720A's command set is also designed to provide high speed transfers to a computer. These commands allow defining: which acquired channels are to transfer data; whether the full set of waveform data or part of a record is to be transferred; and how many records to transfer if in Auto-Advance mode. This capability allows all acquired data to be transferred with a single command, which significantly lessens the time addressing and unaddressing the instrument. For applications requiring repeated transfers (i.e., acquire, transfer, acquire, transfer,...) the RTD 720A provides a command that allows waveform data transfer without the need to issue commands to the instrument for each transfer. Again, this lessens the time required to issue commands and for the instrument to decode the commands, which speeds the data transfer process. These capabilities are available for both the GPIB and parallel ports.

System Support

The RTD 720A is designed as a system product. Besides the hardware and firmware capabilities described above the RTD 720A has additional features addressing system applications. These include:

- Fiducial Input
- External Arming
- External Clocking
- External Triggering
- Trigger Out Signal
- Optional Display Unit that can be moved from instrument to instrument and can be used for controlling the instrument and waveform viewing.



RTD 720A

These capabilities are further supported with an "Engineering English like" command set that eases the task of software development. The optional Display Unit also has a Debug mode that allows viewing of the GPIB traffic to the instrument with error and event condition reporting.

Another important system capability is the maintaining of the highest accuracy and signal fidelity. The RTD 720A provides a Standardize function, instrument diagnostics, and power-on diagnostics (power-on diagnostics can be turned off by the user) to meet these requirements. The Standardize function (executing only upon user request either over the GPIB or from the Display Unit) is used to maintain the highest accuracy. Power-on and instrument diagnostics are used to verify the proper functioning and performance of the instrument.

For benchtop use the RTD 720A Display Unit provides waveform viewing and full instrument control. There is hardcopy capability using either a video copier attached to the Display Unit or to a plotter using the GPIB (Talk Only mode) initiated from the Display Unit. The RTD 720A also supports Tektronix TEKPROBE I/F allowing the use active (FET) and optical probes as well as passive probes.

High Fidelity Waveform Capture

The RTD 720A provides high fidelity capture of transient events. Offering an unmatched combination of signal quality, sample rates, and record lengths providing the performance needed for the capture of fast transient signals.

Characteristics

VERTICAL

Input Channels – Two (optionally Four) single ended BNC's with Tektronix TEKPROBE Interface. Simultaneous digitizing on all channels, in Dual and Quad modes of operation. Four input channels (Quad Mode) requires Opt. 06.

Input Ranges, Offsets – 50 mV full scale to 12.5 V full scale in 25 ranges with each range 1.25 times the previous range. Each range provides an independent ±100% offset capability with fast overdrive recovery (≤20 nsec from a 2 times overdrive signal).

Bandwidth (–3 dB) – DC coupling: DC to ≥500 MHz; AC coupling: ≤1.5 KHz to ≥500 MHz.

Input Accuracy (after Standardization – Mean Value): – Δ DC Volts: ±(1% of Signal +1% of Full Scale Input Range); Offset: ±(1% of Full Scale Input Range + 0.5% of Offset Range +1% of Offset Value).

Maximum Input Voltage & Input Protection – DC coupled 5 VRMS (0.5 W into 50 Ω) or 0.25 Watt-second pulses not to exceed 25 V peak. AC coupled same as DC with ±100 VDC + peak AC.

Fiducial Input – BNC signal input in parallel with CH 1 for providing a time marker to allowing cross timing references between multiple units.

Vertical Resolution – 8 bits providing 256 discrete levels (≈ 50 dB dynamic range).

Sample Rates – 2 GS/s (500 picoseconds/point) to 5 MS/s (200 microseconds/point).

Transient Waveform Digitizers

ACQUISITION MEMORY
Standard instrument 128K waveform data points.
Option 10: 512K waveform data point with battery backed-up.
Option 11: 1M waveform data points.
Option 15: 4M waveform data points.

All memory is shared equally among active channels (1, 2, or 4) with user selection of active channels. User also has control of record size selection from 512 waveform data points to the full memory available, in a binary sequence (i.e., 512, 1024, 2048, ...).

Multiple Records (Auto-Advance) – Memory can be further segmented in up to 1024 records per channel. Maximum number of records equals:
Total Acquisition Memory ÷ (# of Active Channels X Record length)
Re-arm time between records in Auto-Advance Mode is ≤5 µsec plus pre-trigger fill time.

TRIGGERING
Sources – Internal from any channel (active or inactive) or External.

Trigger Coupling & Impedance – DC and AC. Impedance for Internal is the same as input channel coupling (50 Ω); for External 50 Ω ±5%.

Trigger Slope – Positive or Negative.

Trigger Modes – Normal (unit will wait indefinitely until a valid trigger occurs) and Auto (a trigger will be generated after approximately 60 ms if a valid trigger does not occur).

Trigger Time Accuracy (including jitter) – Channel 1: 1 sample interval RMS; Dual Channel: 0.5 sample interval RMS; Quad Channel: 0.25 sample interval RMS.

Pre-Trigger Capture (Waveform data captured prior to the Trigger event) – From ≈ 100% of the Record Length to 0% in increments of 64 sample intervals.

Post-Trigger Capture (Waveform data captured after the Trigger event) – From 0% of the Record Length to 99,999,999 sample intervals after the trigger. For post-trigger mode, acquisition begins after the post-trigger delay set and captures the full defined record length.

Arming – Internal or External. Triggers are not recognized unit the unit is armed. External Arm is a BNC input that arms on a switch closure to ground (internal pull-up provided to 5 V).

Trigger Out Signal – A TTL low level (≤0.8 V) output at the BNC after trigger and remains low during the acquisition cycle.

COMPUTER INTERFACES
GPIB – IEEE-488-1 interface is standard for instrument control and waveform data transfer. Maximum transfer rate ≥500 Kbytes/sec.

Parallel Port – A waveform data output only 16-bit wide TTL level parallel port is provided capable of 2 Mwords (4 Mbtyes) data transfer rates.

DISPLAY & INSTRUMENT CONTROL
Optional Display – Provides for waveform viewing and instrument control. Display can be remotely mounted and moved from instrument to instrument by simply moving the connecting cable.

Hardcopy – The display also supports a video hardcopy capability (EGA compatible) and with the Display Unit plotter output over the GPIB is available without the need for a controller/computer.

ENVIRONMENTAL (STANDARD INSTRUMENT)
Temperature Range – Operating –10°C to 55°C; Non-operating –51°C to 71°C.

Humidity – 0% to 95% relative humidity (non-condensing).

Altitude – Operating to 4.5 Km (15,000 ft.) maximum; Non-operating to 15 Km (50,000 ft.) maximum.

POWER REQUIREMENTS
Line Frequency – 48 to 440 Hz.

Voltage Range – Selected by rear panel switch 90 to 132 VRMS or 180 to 250 VRMS.

Power Consumption – ≤ 500 Watts fully optioned (typical ≤ 350 Watts).

Warranty – The RTD 720A carries a standard Tektronix one-year warranty covering labor and replacement parts for the instrument.

PHYSICAL CHARACTERISTICS

Dimensions	mm	in.
Width	482.6	19
Height	225.25	8.75
Depth	635	25
Weight ≈	**kg**	**lb**
Net	19	49

ORDERING INFORMATION

RTD 720A
Transient Event Digitizer ..... TD **$23,200**
Includes: 2 input channels and 128K acquisition memory; power cord; fuses; User's Manual (070-8516-00); Programmer's Manual (070-8518-00); Quick Reference Guide (070-8517-00); and rack mount kit.

Opt. 06 – Four (4) acquisition channels (adds 2 additional full function channels) ..... **+$2,500**
Opt. 10 – 512K battery backed-up acquisition memory ..... **+$5,500**
Opt. 11 – 1M acquisition memory ..... **+$7,000**
Opt. 15 – 4M acquisition memory ..... **+$12,500**
Opt. 19 – Optional remote mountable display for waveform viewing and instrument control. ..... **+$2,900**

INTERNATIONAL POWER PLUG OPTIONS
Opt. A1 – Universal Euro 220 V, 50 Hz ..... **NC**
Opt. A2 – United Kingdom 240 V, 50 Hz ..... **NC**
Opt. A3 – Australian 240 V, 50 Hz ..... **NC**
Opt. A4 – North American 240 V, 60 Hz ..... **NC**
Opt. A5 – Switzerland 220 V, 50 Hz ..... **NC**
See General Customer Information Section for additional description.

PROBES
See page 423 for complete probe selection.
Active – 1 GHz, 1.9 pF/10 MΩ, 1.5 m. Order P6204 ..... **$1,495**
750 MHz, 2 pF/1 MΩ, 1.5 m. Order P6205 ..... **$495**
Differential – 100 MHz, active differential. Order P6046 ..... **$2,195**
50 Ω Divider – 50 Ω inputs. Divider probe set includes both of the following: 3.5 GHz, 1 pF/500 Ω; 3 GHz, 1 pF/5000 Ω, 1.5 m. Order P6156 with Opt. 25 ..... **$325**
Current –
120 Hz – 60 MHz, 7.5 A peak. Order P6021 ..... **$545**
935 Hz – 120 MHz, 3 A peak. Order P6022 ..... **$595**
DC – 50 MHz System. Includes AM503A, A6302, TM502A. Order AM503S **$2,595**

ADDITIONAL ACCESSORIES
Plotter – Order HC100 with Opt. 01 ..... **$1,180**
Video – HC02A **$3,100**

TD
Product also available through an Authorized Tektronix Distributor (listed on page 540).

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

GPIB IEEE-488
The RTD 720A of Digitizers complies with the IEEE Standard 488.1 and Tektronix Standard Codes and Formats.

RTD 710A
TD 1301

Transient Digitizer Digitizer System

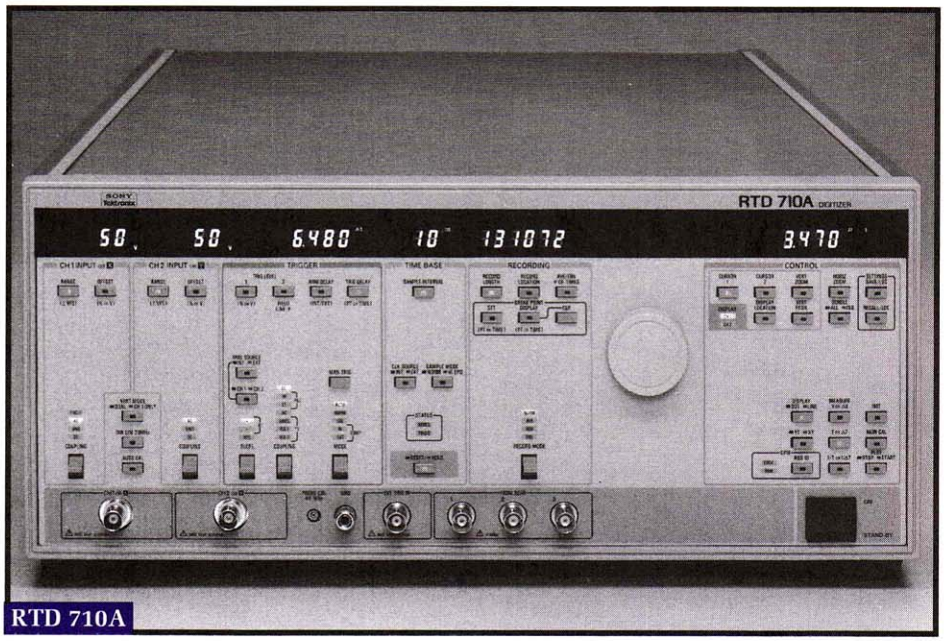
High resolution, accuracy, and speed.

RTD 710A

- 10 Bit Vertical Resolution
- 200 MS/s Single Channel
- 100 MS/s Dual Channel
- 100 MHz Analog Bandwidth
- 256K Word Waveform Memory
- Hardware Signal Averaging
- Internal/External A/D Clocking
- Cursor Measurements of Time, Voltage and Frequency

APPLICATIONS

- Video and HDTV
- Ultrasonics, Radar, Lidar
- High Voltage Impulse Testing
- Power Supply & Power Conversion
- Communications and EW
- CCD Development
- Semiconductor & Hybrid Test
- ATE Systems



Programmable Waveform Digitizer

RTD 710A Waveform Digitizer

- High Resolution and Accuracy
- Synchronized Clocking
- Long Record Length
- Expandable Waveform Memory

HIGH RESOLUTION, ACCURACY AND SPEED

The RTD 710A Waveform Digitizer provides 10 bit vertical resolution at sample rates up to 200 Megasamples per second (MS/s). With four times the resolution of an 8-bit digitizer and 60 dB of dynamic range, the RTD 710A provides excellent resolution of fine signal details.

The RTD 710A provides real-time digitizing up to 200 MS/s in the single-channel mode and to 100 MS/s in dual-channel mode. The high performance amplifier and attenuator system, along with Autocal circuitry, provides excellent signal fidelity prior to conversion from analog to digital form. The input system also provides fine control of full scale input range and offset, maximizing use of the 1024 available digitizing levels.

Other key features of the input system are accurate step response and rapid overdrive recovery. Clean step response is important for accurate capture of transient events. The fast overdrive recovery allows accurate recording of small events occurring near large impulses, such as in pulse-echo applications and decaying exponential signals.

LONG MEMORY AND FLEXIBLE RECORDING

The RTD 710A contains 256K (262, 144) words of high-speed memory for storing waveform data. Memory can be allocated entirely to one channel or split between channels for simultaneous dual-channel digitizing.

Record length can be selected from 1024 points to the full 262, 144, in powers of two. When using shorter lengths, a correspondingly larger number of records are available. With a record length of 1024 points, up to 128 records per channel are available in the dual-channel mode, or up to 256 records if single channel is used.

DIRECT OUTPUT OF A/D DATA

For applications where the large internal memory of the RTD 710A is not enough, an external output port is provided. The output of both A/D converters is available up to the full 200 MS/s rate. External memory caches, such as the Tektronix 9503/9504 FDC may be added for capture of extremely long time windows with high resolution. Contact your Tektronix Sales Engineer for further information on memory cache products.

TD

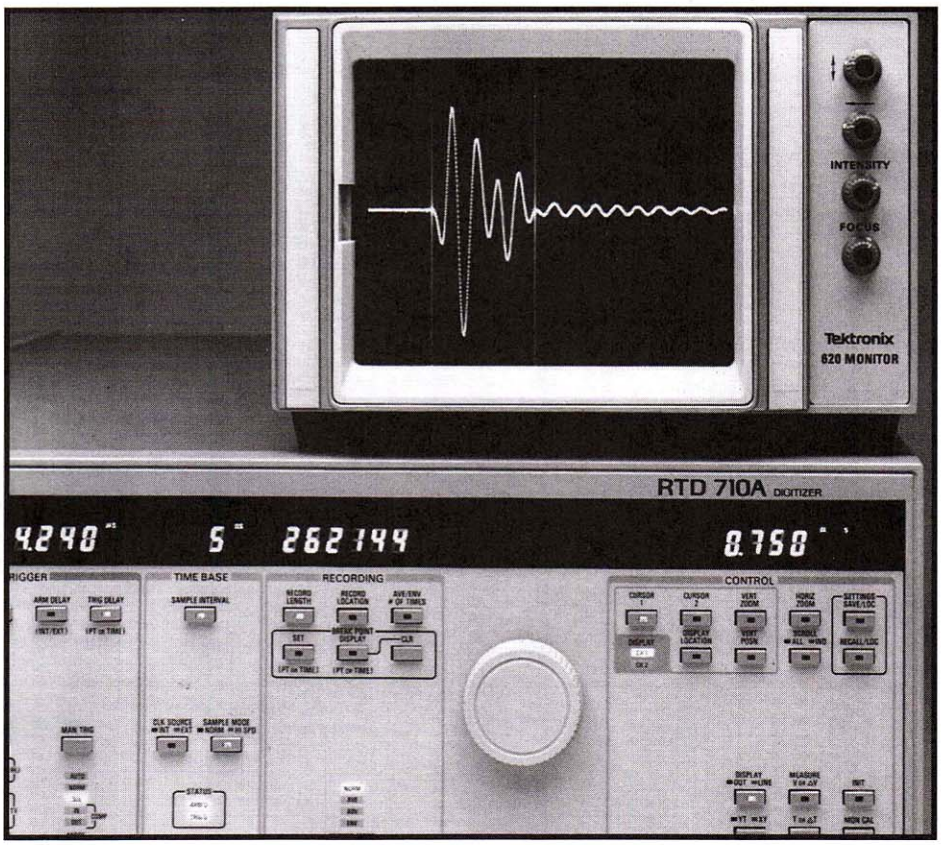
Product also available through an Authorized Tektronix Distributor (listed on page 540).

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

GPIB IEEE-488

The RTD 710A Digitizer complies with the IEEE Standard 488.1 and Tektronix Standard Codes and Formats.

Transient Digitizer Digitizer System



OTHER RECORDING MODES

The Auto-Advance recording mode takes advantage of multiple records by capturing new waveform data on successive trigger events. In this manner a series of transient events can be captured in rapid succession and held for later analysis. Auto-Advance recording is very powerful for capturing a series of lightning strikes, monitoring the time-varying output of a laser system, or recording other sequential transient phenomena.

In addition to the transient recording modes, the RTD 710A has built-in hardware signal averaging capability. This provides selectable powers-of-two averaging up to 16K times to reduce random signal noise.

Envelope capture mode records minimum and maximum values for each data point over successive acquisitions. This offers a powerful technique for capturing spurious events and for monitoring signal drift.

INTERNAL AND EXTERNAL SAMPLE CONTROL

In addition to 66 internal time base settings, external strobing of the A/D converter system is supported. This provides the ability to synchronize sampling with external phenomena. The RTD 710A can be strobed from DC to 200 MHz. One typical application is CCD development where sampling can be synchronized with the CCD shift clock. Other applications are storage media testing and multiplexed data systems.

Sample rate switching is a unique feature provided to optimize usage of waveform memory. With sample rate switching it is possible to perform fast sampling during periods of interest and switch to a slower rate during quiescent periods. Up to 5 breakpoints (sample rate changes) are available within a record. One application is ultrasonics, where dead time between impulse and echo events can be sampled at a low rate while maintaining fast sampling over the events of interest. This can significantly reduce the amount of data transferred for processing in a computer.

VERSATILE TRIGGERING MODES

The RTD 710A offers many trigger modes to simplify the capture of complex signals. Standard oscilloscope-like triggering is provided along with enhancements such as LF or HF Reject, Bislope triggering and a Hysteresis trigger mode. Hysteresis mode allows the user to set an analog qualifying level as well as a trigger level, providing noise immunity and additional trigger selectivity.

A Video Trigger Option is available to allow the user to trigger on horizontal or vertical video sync pulses. This option makes it possible to trigger on a specific line number within a video field. Back porch clamp is provided.

In Comparison triggering mode, the RTD 710A continuously acquires events and compares them to reference-waveform values. If an event deviates from the range of values (Compare Out mode) or lies entirely within them (Compare In mode), the waveform is held for further analysis.

WAVEFORM ZOOM AND CURSOR MEASUREMENTS

When used in conjunction with an optional X-Y-Z monitor, captured waveforms can be viewed and measured in several ways. Cursors offer the capability to measure time, voltage and frequency. The RTD 710A offers horizontal and vertical display zoom, vertical positioning, and horizontal scrolling for easy viewing of the entire waveform or expansion of smaller portions. Both YT and XY types of displays are available.

Continued on next page.

RTD 710A
TD 1301

Transient Digitizer Digitizer System

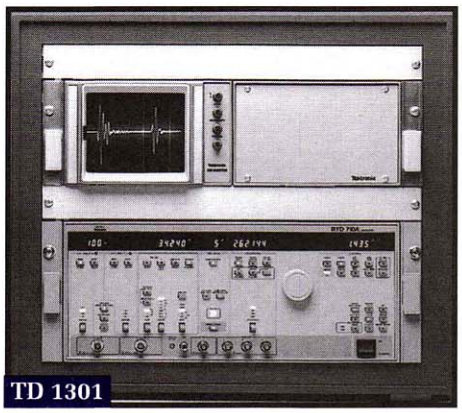
STANDALONE OR SYSTEM DIGITIZER

The RTD 710A is fully programmable via the GPIB IEEE-488 and conforms to Tektronix Standard Codes and Formats. It also contains several useful waveform analysis commands, such as Min, Max, and Cross to increase throughput in test systems.

Hardcopies of the display can be made with the HC100 Color Plotter via the GPIB. Option 19 provides a blank instrument front panel. This eliminates the RTD 710A front-panel controls, reducing power consumption, instrument cost and susceptibility to undesired operator adjustment. This is particularly important in test-system environments.

Quicker system set-up time and the convenience of choosing from several previous instrument states is standard on the RTD 710A via non-volatile settings storage. Up to 20 different instrument states can be stored and recalled by either a front-panel push button or under computer control.

Measurement accuracy and proper functioning of the RTD 710A are confirmed by auto-calibration and self-test procedures. Self-test is automatically performed at power-on, and can be user-activated during operation.



TD 1301 Acquisition and Viewing package includes RTD 710A, 620 monitor, cabinet and mounting hardware.

TD1301 System

- RTD 710A, Option 1R Digitizer
- 620 Monitor
- Standard 19-inch Components
- Cables and Rack Slides
- Cabinet

Characteristics

VERTICAL

Input Channels – Two, single-ended. Supports X10 and X100 encoded probes for high input-voltage applications. Simultaneous digitizing in dual-channel mode.

Input Ranges – ±100 mV to ±50 V (200 mV to 100 Vp-p) in 28 steps.

Autocal Internal Reference – Provides calibration of range accuracy and zero-offset. Range accuracy is ±0.4% at 1 kHz and 97% full-scale, zero volt offset is ±0.2%.

Input Offset – ±199% of input range, selectable in either percent or volts. Accuracy ±1.5% at ±100% DC offset.

Analog Bandwidth – DC to 100 MHz, 0°C to 40°C; DC to 90 MHz, 40°C to 50°C. Selectable bandwidth limiting at 20 MHz.

AC-Coupled Lower – 3 dB Point – 10 Hz or less.

Input R and C – 1 MΩ ±2%, ≈ 24 pF.

Maximum Input Voltage – 250 V (DC + peak AC); AC component, 500 Vp-p maximum at 1 KHz or less.

TIME BASE

Internal Clock Frequency – 200 MHz ±0.001%.

Sample Rate: Internal Clock – Channel 1 Only Mode: 200 MS/s to 5 S/s, 66 sampling steps. Dual-Channel Mode: 100 MS/s to 5 S/s, 65 sampling steps.

External Clock – Channel 1 Only Mode: DC to 200 MHz, Dual-Channel Mode: DC to 100 MHz. ECL levels, periodic or non-periodic clock rate.

Sample Rate Switching – Up to 5 breakpoints within a record.

DIGITIZING

Vertical Resolution – 10 Bits provide 1024 discrete levels (60 dB dynamic range).

Maximum Sample Rate –
Single-Channel Mode: 200 MS/s.
Dual-Channel Mode: 100 MS/s.

Record Length per Channel –

CH 1 Only Mode		Dual-CH Mode	
Records	Length	Records/CH	Length/CH
1	262144	1	131072
2	131072	2	65536
4	65536	4	32768
8	32768	8	16384
16	16384	16	8192
32	8192	32	4096
64	4096	64	2048
128	2048	128	1024
256	1024	—	—

Averaging – Selectable from 2 to 16384 in a 2-4-8 binary sequence, 8K per channel maximum record length averaged.

Enveloping – Selectable from 1 to 16384 in a 2-4-8 binary sequence or infinite.

TRIGGERING

Sources – Internal from CH 1 or CH 2, or External.

Trigger Coupling – AC, AC LF Reject, DC HF Reject, DC.

Slope – Positive, Negative, Bislope.

Modes – Auto, Normal, Single, Compare In, Compare Out, Hysteresis.

Post-Trigger Delay – From 0 to 262136 samples in Normal Mode, from 0 to 262128 samples in high-speed (200 MS/s) mode.

Pre-Trigger Capture – To full record length less 8 samples for normal mode and full record length less 16 samples for high-speed (200 MS/s) mode.

Arming Delay – Internal: 0, 10 ms to 10 s in a 1-2-5 sequence; External arm input on rear panel.

TV Trigger – Selectable system-M and non-system-M protocols. Selectable triggering on any line (1 to 1280) within a field (1 or 2). TV blanking-level clamp (back porch).

DISPLAYS

Cursor Readout – 7-digit LED display for time, voltage and frequency.

Trigger Readout – 6-digit LED display for trigger level.

Record Length Readout – 6-digit LED display for record length and breakpoint location.

Range/Offset Readout – 4-digit LED display for range and offset settings; two displays, one for each channel.

Transient Digitizer Digitizer System

RTD 710A
TD 1301

COMPUTER INTERFACE

GPIB – IEEE-488.1 interface is standard for instrument control and waveform data transfer. Maximum transfer rate ≥250 kilobytes/s. All instrument functions, settings, and operating modes are programmable, with the exception of the power switch.

Plotter Interface – HPGL Protocol, IEEE-488 interface.

Waveform Analysis Commands – Window, Minimum, Maximum, Base, Top, Positive Cross, Negative Cross, Mid, Mean, Peak to Peak.

EXTERNAL SIGNALS

CRT Display – X,Y,Z: ±1 and ±5 Vp-p, internally selectable (set to ±1 V at factory).

Trigger Output – Positive True, TTL.

External Arm Input – TTL Compatible.

External Clock Input – ECL Signal Level, 50 Ω. DC to 200 MHz.

Clock Output – ECL signal level (open emitter out into 50 Ω).

Probe Calibration Output – 0 to + 4 V ±1% square wave at 1 kHz ±0.005% into 1 MΩ.

Feed-Through Connectors – Three 50 Ω co-axial cables for front-to-rear signal connections.

Direct A/D Output – 50 pin AMPMODU MT connector. CH 1 and CH 2 digitized signals available. ECL-compatible signal levels. Maximum data rate is 100 megawords/s (20 bit word). Contact Tek Sales Engineer for information on memory cache products and interfacing information.

ENVIRONMENTAL

Temperature Range – Operating: 0° to 50°C; Non-operating: –30° to +70°C.

Humidity – 0 to 95% relative humidity (non-condensing).

Altitude – Operating: 4,570 m (15,000 ft.) max. Non-operating: 15,240 m (50,000 ft.) max.

POWER

Line Frequency – 48 Hz to 440 Hz.

Power Consumption – 350 W fully optioned.

Line Voltage Range – 90 VAC to 132 VAC (115 V); 180 VAC to 250 VAC (230 V).

PHYSICAL CHARACTERISTICS

Dimensions	mm	in.
Width	429	16.9
Height	177	7.0
Depth	643	25.3
Weight ≈	**kg**	**lb**
Net	23.5	51.8

ORDERING INFORMATION

RTD 710A
Waveform Digitizer ..... TD **$22,995**
Includes: (161-0123-00); Fuses (8A & 4A); Instruction Manual (070-7204-00); RTD 710A Instrument Interfacing Guide (070-7207-00).
Opt. 05 – Video Trigger ..... **+$1,495**
Opt. 09 – Adds 9503 Fast Data Cache for 4 megawords total memory ..... **+$20,000**
Opt. 11 – Adds 9504 Fast Data Cache for 8 megawords total memory ..... **+$37,000**
Opt. 19 – Blank Front Panel (Includes Rack Mount Assembly) **–$200**
Opt. 1R – Rack Mount Package ..... **+$395**

TD 1301
Acquisition and Viewing Package **$28,000**
Includes: RTD710A Opt. 1R; 620 monitor; cables; rack slides; cabinet.
Opt. 05 – Video Trigger ..... **+$1,495**
Opt. 1D – Delete Cabinet ..... **–$750**
Opt. 2D – RTD710A Blank Panel ..... **–$200**
Opt. 1H – Add HC100 Plotter (120 V) ..... **+$1,180**
Opt. 2H – Add HC100 Plotter (240 V) ..... **+$1,180**
A/D Out Cable – RTD 710A to 9503/9504 2 m. Order 012-1117-01 ..... **$205**
GPIB Cable – 2 m. Order 012-0991-00 ..... **$170**
Monitor – Order 620 ..... **$1,910**

INTERNATIONAL POWER PLUG OPTIONS
Opt. A1 – Universal Euro 220 V, 50 Hz ..... **NC**
Opt. A2 – United Kingdom 240 V, 50 Hz ..... **NC**
Opt. A3 – Australian 240 V, 50 Hz ..... **NC**
Opt. A4 – North American 240 V, 60 Hz ..... **NC**
Opt. A5 – Switzerland 220 V, 50 Hz ..... **NC**
See General Customer Information Section for additional description.

WARRANTY-PLUS SERVICE OPTIONS
Opt. M9 – Repair Protection ..... **+$800**

PROBES
See page 423 for complete descriptions and full line of probes.
Differential – 100 MHz, active differential, 6 ft. Order P6046 ..... **$2,195**
High Voltage –
120 MHz, 1500 V, 2.5 pF/10 MΩ, 9 ft. Order P6009 ..... **$265**
75 MHz, 20 kV, 3.0 pF/100 MΩ, 10 ft. Order P6015A (Opt. 1R) **$950**
Current – 120 Hz – 60 MHz, 7.5 A peak. Order P6021 ..... **$545**
935 Hz – 120 MHz, 3 A peak. Order P6022 ..... **$595**
DC – 50 MHz System. Includes AM503A, A6302. Order AM503S **$2,595**

RECOMMENDED ACCESSORIES
RTD 710A Service Manuals –
Vol. 1 Procedures. Order 070-7205-00 ..... **$70**
Vol. 2 Schematics. Order 070-7206-01 ..... **$60**
Rackmount Kit – Order 016-0886-02 ..... **$435**
Plotter – Four color. Order HC100 with Opt. 01 ..... **$1,180**
Cart – Order K217S **$780**

TD
Product also available through an Authorized Tektronix Distributor (listed on page 540).

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

GPIB IEEE-488 — The RTD 710A Digitizer complies with the IEEE Standard 488.1 and Tektronix Standard Codes and Formats.

Fast Data Cache

Extremely high speed digital data storage.

9503/9504

- Long Record Length
  - 4 Mwords Total in 9503
  - Up to 32 Mwords in 9504
- Data Rates to 100 Mwords/s, Dual Channel or Inter-leaved for 200 Mwords/s, Single Channel
- 16 bit or 8 bit Word Width Selectable
- GPIB Controlled
- ECL or TTL Data Inputs (25 Mwords/s TTL)

APPLICATIONS

- Acquisition memory extension for the RTD 710A
- High Resolution Video and CCD Test Systems
- "Deep Record" Ultrasonic, Radar, and Lidar Signal Acquisitions
- EW and EMC Signal Capture
- Storage Media Test Systems
- Tempest Applications
- Fast Data Logging of Complex Waveforms

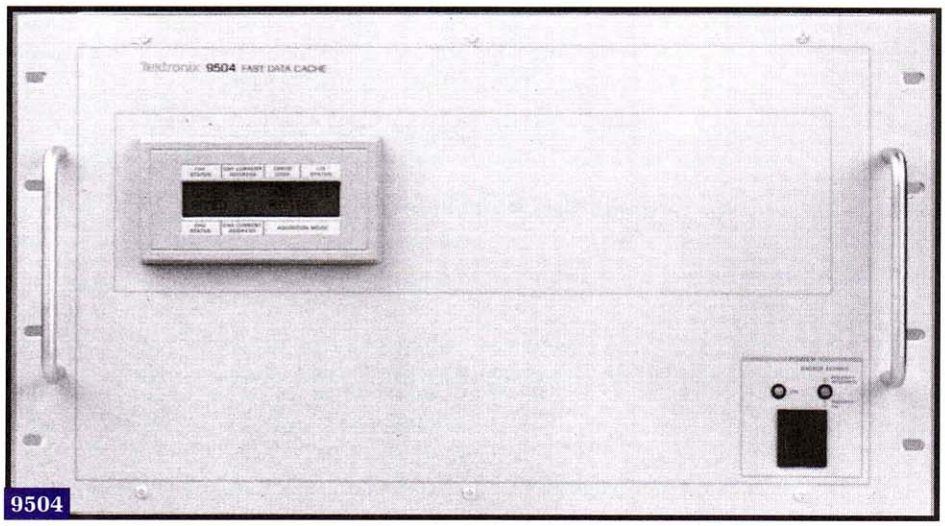
TD

Product also available through an Authorized Tektronix Distributor (listed on page 540).

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

GPIB IEEE-488

The 9500 Series of Fast Data Caches complies with the IEEE Standard 488.2 and Tektronix Standard Codes and Formats.



9504

9503/9504 Fast Data Cache

- Extremely Long Record Length
- Data rates to 100 megaword/s
- Partitionable Memory
- Very Fast Data Logging

The 9503/9504 Fast Data Cache buffer memories provide significant record length augmentation for high- speed, real-time digitizers. The 9503 is a memory buffer configured for 2 megawords per channel or 4 megawords single channel. The 9504 is an expandable memory buffer that starts with 4 megawords total memory and can be increased to a total of 32 megawords.

LONG RECORD CAPTURE

They provide the economical solution to your digitized data storage needs for the logging of high speed, real- time data records. The 9503 and 9504, in conjunction with the RTD 710/A waveform digitizer, provide the fastest real-time data logging capability for multiple, complex waveforms in their class. The 9503 and 9504 support the high-speed single channel mode of the RTD 710A to capture data up to 200 megawords/s.

The 9503 or 9504 provides storage of long data records obtained from high speed analog-to-digital converter. Each product accepts up to 16-bit-wide words plus clock, at up to 100 megawords (samples) per second. Record lengths may be from 256 words to 16 megawords per channel. In either product, the two channels may be concatenated into one long memory.

FULL DIGITIZER COMPATIBILITY

Full dual-channel operation makes the 9503 and 9504 fully compatible with the A/D outputs of the RTD 710 and RTD 710A waveform digitizers. They also accept data from the RTD 710/A operating in the high-speed mode to provide data storage at an effective sampling rate of 200 megawords/s. The standard configuration for either product provides 2 megawords of memory per channel. The 9503 memory length is fixed at 2 megawords per channel.

The 9504 can be configured with additional 2 megaword memory cards, to provide a maximum of 16 megawords of memory per channel.

ECL DIFFERENTIAL OR TTL LEVEL INPUTS

The 16-bit inputs are selectable in groups of 4, and can be programmed for either ECL or TTL. Rear-panel BNC connectors allow control of start and trigger of data collection. The trigger input can also be connected to use the highest of the 16 bits as an information flag.

MULTIPLE RECORDS CAPABILITY

Memory can be divided into a user-specified number of records with record length specified in segments of 256 words. Each record may be any number of 256-word segments up to the maximum size of the memory in that channel. Up to 64K separate records (256 words each) may be stored per channel in the 9504. Multiple records capability is supported in all operation modes except pretrigger.

OPERATIONAL MODES

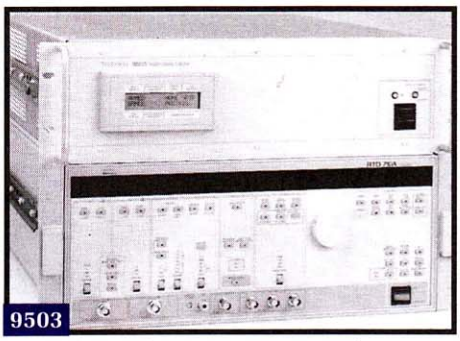
The 9503 and 9504 Fast Data Cache units allow the storage of very long data streams which have been acquired and digitized by high-speed, real-time waveform digitizers, such as the RTD 710A. These system units are GPIB-controlled, and stored data is output via GPIB or over the high-speed parallel port.

Normal (Independent) Mode – Both channels accept independent data streams and triggers.

Interleave Mode – Allows storage of data from Channel 1 memory to be interleaved with data from Channel 2 memory. Supports the RTD 710A high speed mode at 200 megawords/s single channel. Assumes RTD 710A Channel 1 data point zero to be first in combined record.

Fast Data Cache

9503
9504



RTD 710A with 9503 Fast Data Cache

Sequential Mode – Data is stored in Channel 1 memory until it is full; data storage then continues in the Channel 2 memory. This mode provides for all available memory to be continuous without any break in timing. The data inputs to Channels 1 and 2 must be identical.

Pretrigger Mode – This mode connects the available channel memory into a circular buffer. The number of data words to be stored after the "trigger" is user selectable in 256 word increments.

FAST THROUGHPUT CAPABILITY
The 9503 and 9504, when used in conjunction with the RTD 710/A or other digitizers having continuous digitized signal output capability, allow the capture and storage of large quantities of signal waveforms at very rapid rates. The chart below shows typical waveform capture rates (data logging throughput) for representative record sizes and sampling rates. A TTL level trigger signal is required for each record.

TYPICAL WAVEFORM ACQUISITION RATES/SEC

Record Size	Max*1 No. of Records Stored (9504)	Input Sample Rate 100 MHz (10 ns)	50 MHz (20 ns)	10 MHz (100 ns)
256	65,536	>380K	>190K	>38K
512	32,768	>190K	>95K	>19K
1,024	16,384	>95K	>48K	>9.5K
2,048	8,192	>48K	>24K	>4.5K
8,192	2,048	>12K	>6K	>1.2K
16,384	1,024	>6K	>3K	>0.6K

**1 Each channel (2X for single channel mode).*

Characteristics

DIGITAL INPUT/OUTPUT SIGNALS
Number of Channels – Two independent channels.

Data Inputs – 16 bits, clock, ground; Selectable between ECL and TTL, in groups of 4 bits.

Data Input Rates – Up to 100 MHz: ECL. Up to 25 MHz: TTL.

Start Input – Starts data capture in Pretrigger Mode; TTL signal into BNC.

Trigger Input – Starts data capture in all modes except Pretrigger and marks trigger location on data. TTL signal into BNC.

Arm Out – TTL signal from BNC. TTL low while filling data record. Inhibits RTD 710/A rearm while 9503/9504 record is filling.

MEMORY SIZE
9503: 2 megawords/CH: or 4 megawords total.
9504: 2 megawords/CH; Expandable to 16 megawords/CH or 32 megawords total.

COMPUTER INTERFACES
GPIB – IEEE-488.2 and Tektronix Standard Codes and Formats.

Parallel Port – A waveform data (output only) 16 bit parallel port is provided capable of 5 megabytes/s (2.5 megawords/s). This provides TTL level outputs and has operating modes to allow use with a wide range of computers.

ENVIRONMENTAL
Temperature Range – Operating: 0°C to 50°C. Non-operating: –20°C to +60°C.

Relative Humidity – 0 to 95%; noncondensing.

Altitude – Operating: 4,750 m (15,000 ft.) max. Non-operating: 15,240 m (50,000 ft.) max.

POWER
Line Frequency – 48 to 63 Hz.

Maximum Power Consumption – 9503: max 360 W (285 W typical). 9504: max 735 W (580 W typical) for maximum memory.

Battery Backup – Connector for battery on rear of instrument. 9503: 4.75 to 15 VDC, 100 mA maximum (fused). 9504: 4.75 to 15 VDC, 450 mA maximum (fused).

PHYSICAL CHARACTERISTICS

	9503		9504	
Dimensions	**mm**	**in.**	**mm**	**in.**
Height	133	5.25	267	10.5
Rack Depth	574	22.6	574	22.6
Overall Depth	622	24.5	622	24.5
Width	483	19.0	483	19.0
Weight ≈	**lb**	**kg**	**lb**	**kg**
Net	12.3	27	17.3	38

9504F01 Fast Data Cache Memory Module

Two megawords (4 megabytes). Adds 2 megawords of additional storage to one channel of the 9504 Fast Data Cache unit. Order in pairs to extend both channels by the same amount.

ORDERING INFORMATION

9503
Fast Data Cache Unit ..... TD **$20,000**

9504
Fast Data Cache Unit ..... TD **$23,000**

9504F01
Fast Data Cache. 2 megaword memory Module ..... TD **$7,500**

INSTRUMENT OPTIONS (9504 only)
Opt. 11 – (8 MW total) Adds 2 ea. 9504F01 ..... **+$14,000**
Opt. 12 – (12 MW total) Adds 4 ea. 9504F01 ..... **+$28,000**
Opt. 13 – (16 MW total) Adds 6 ea. 9504F01 ..... **+$42,000**
Opt. 14 – (20 MW total) Adds 8 ea. 9504F01 ..... **+$56,000**
Opt. 15 – (24 MW total) Adds 10 ea. 9504F01 ..... **+$70,000**
Opt. 16 – (28 MW total) Adds 12 ea. 9504F01 ..... **+$84,000**
Opt. 17 – (32 MW total) Adds 14 ea. 9504F01 ..... **+$98,000**

INTERNATIONAL POWER PLUG OPTIONS
Opt. A1 – Universal Euro 220 V, 50 Hz ..... **NC**
Opt. A2 – United Kingdom 240 V, 50 Hz ..... **NC**
Opt. A3 – Australian 240 V, 50 Hz ..... **NC**
Opt. A4 – North American 240 V, 60 Hz ..... **NC**
Opt. A5 – Switzerland 220 V, 50 Hz ..... **NC**

See General Customer Information Section for additional description.

TD
Product also available through an Authorized Tektronix Distributor (listed on page 540).

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

GPIB IEEE-488 — The 9500 Series of Fast Data Caches complies with the IEEE Standard 488.2 and Tektronix Standard Codes and Formats.

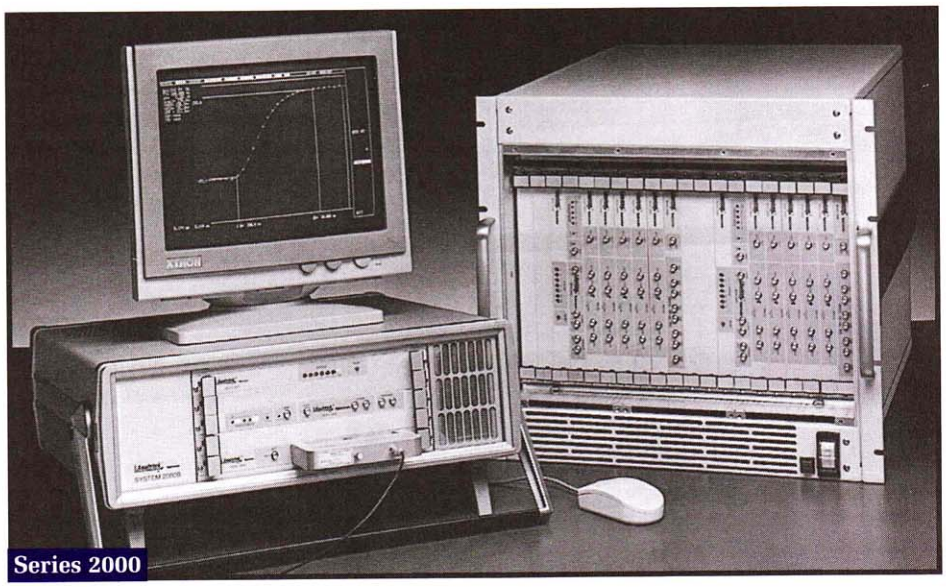
SERIES 2000

Analytek Waveform Capture Systems

Unmatched combination of high acquisition rates and input channel density with low power requirements.

SERIES 2000

- High Speed Transient Capture (up to 2 GS/s)
- High Throughput Capability (greater than 10K events/sec)
- 12 Bits Resolution
- High Channel Density (up to 196 channels)
- Easy to Use Mouse-Driven Interface
- Expandable VME Based System (with GPIB and RS-232C Support)
- Portable Standalone and Modular Systems



Series 2000

APPLICATIONS

Impulse Phenomena –
- High Energy Physics
- Laser Induced Phenomena
- EMP and Radiation Simulators
- Nuclear Effects
- High Voltage Breakdown

Pulse Echo Events –
- RADAR
- LIDAR

Laboratory Testing –
- Solid State Devices
- Detectors
- Lasers
- High Speed and rf Circuits
- Automated Test Equipment
- Physical Chemistry
- Time-Of-Flight Magnetic Resonance Spectroscopy
- Fluorescence Spectroscopy

Material Testing–
- Ultrasonic Non-Destructive Evaluation
- CCD Scanning

GPIB IEEE-488 — The Analytek 2000 Series of Digitizers complies with the IEEE Standard 488.2 and Tektronix Codes and Formats.

Analytek 2000 Series Digitizing System

MULTIPLE ACQUISITION CHANNELS

Each 2004S Sampling Module has four simultaneous acquisition channels with sampling rates of 500 Mega-samples/second (MS/s). With external precision signal splitters, this same Sampling Module can provide either two channels at 1 Gigasamples/second (GS/s) or one channel at 2 GS/s. (These signal splitters also provide an acquisition range for each module from 1 microsecond/point at 1 MS/s to 500 picoseconds/point at 2 GS/s.)

The 2008S Sampling Module provides 8 simultaneous acquisition channels with sampling rates of 250 MS/s.

The 2016S Sampling Module provides 16 simultaneous acquisition channels with sampling rates of 125 MS/s.

SUPERIOR VERTICAL RESOLUTION

Data from the analog signal memory is clocked out at a slower rate to a 12-bit Analog to Digital Converter (ADC). The 12-bit ADC supports a 10.5 bit dynamic range to maximize useful information from the captured signals.

HIGH THROUGHPUT SAMPLING

The 2004HS, a high throughput version of the 2004S Sampling Module, incorporates fast electronics in a companion Accelerator Module. The Sampling and Accelerator Modules are packaged separately so that the Accelerator Module can be configured to serve either one or two Sampling Modules. High Throughput Sampling Modules cannot be combined with other Analytek sampling modules under the control of a single processor. However, processor-sampler subsystems of both regular and high-speed samplers can coexist in a connected system.

Throughput of the 2004HS occurs at a rate of approximately 266 ns per sample point. The 2004HS has a short cycling capability; however, the throughput rate, expressed as a function of records per unit time, depends directly on the record length. For example, the 2004HS can process 440 waveforms per second (at 8192 points per waveform). Alternately at 1024 points per waveform, the throughput is increased to approximately 2300 waveforms per second.

HIGH CHANNEL DENSITY/LOW COST PER CHANNEL

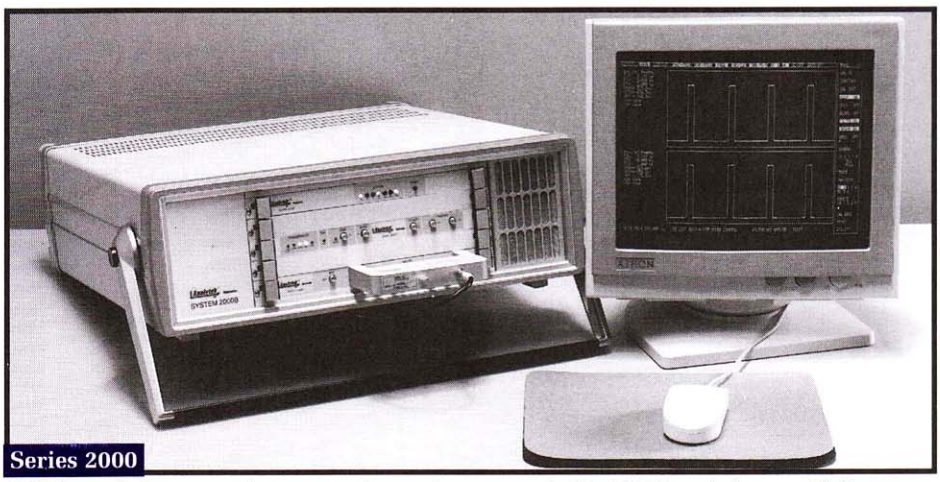
The Analytek Series 2000 provides many acquisition channels in a compact package. The new Series 2000 family of products offer an unmatched combination of high acquisition rates and input channel density with low power requirements. As the number of channels increase, the total cost per channel becomes significantly lower.

SIGNAL AMPLIFIER AND ATTENUATOR

The 2004A Amplifier-Attenuator Module provides four channels of amplification or attenuation, with each channel independently programmable between 100x attenuation (–40 dB) and 10x gain (20 dB). It is designed especially for use with the Analytek waveform sampling modules due to the ability to calibrate the entire sampling channel under the control of the Series 2000 processor.

The 2004A may also be used as a general purpose amplifier-attenuator, independent of other 2000 Series modules. In such general purpose applications, the 2004A Amplifier-Attenuator can be directly register-programmed by a standard VME CPU.

Analytek Waveform Capture Systems



A high resolution monochrome monitor and mouse make the 2000B mainframe with its powerful ROM-resident software a fully standalone system.

TIMING & TRIGGERING
The 2000T Timing Module provides the data clocking signals and triggering signals for the capture of data from the sampling modules. It also supports both pre-trigger and post-trigger acquisition modes. One 2000T is required for each unique grouping of one to six Sampling Modules.

AUTO-CALIBRATION
AC, DC and baseline calibration is provided by the Sampling Module to achieve the highest signal fidelity among the large number of possible channels. The Timing Module generates the source signal for AC calibration.

PROCESSING AND PROGRAMMABILITY
The 2000P Processor Module provides instrument control for up to six Sampling Modules and corresponding Timing Module. The Processor Module also provides GPIB (IEEE-488.2), RS-232C, and VME interfacing capability to external computers. Since these interfaces are supported by a wide range of computers, the acquisition unit can be matched to the unique system requirement, rather than being the limiting or driving factor in system selection.

LOCAL INSTRUMENT CONTROL, WAVEFORM DISPLAY, AND ANALYSIS
The Analytek 2000DM1 Monitor and 2000MC Mouse operate directly with the 2000 Series mainframes to provide an easy-to-use human interface. This interface provides high resolution display of captured waveforms and access to on-screen menus. In addition with this interface, all aspects of the acquisition units are accessible. (Similarly, all setup, control and display functions are controllable via GPIB.)

HIGH PERFORMANCE DATA ACQUISITION WORKSTATION (DAWS)
Waveform acquisition and processing on embedded Intel 386/486 processors (2000PC5). Acting as system controllers and data processors, the 2000PC5 acquires data from a 2000HA Accelerator Module via a 2000MI Cache Memory Interface Module. Waveforms are stored in the adjacent dual port memory modules (up to 64 MB in the 2064MM).

For computation intensive tasks, Analytek offers the 2000API i860 Array Processor (80 MIPS), and Sun Sparc Station 2E Embedded RISC Processor (28 MIPS) combination.

CHASSIS (MAINFRAMES)
2000B Benchtop – Standard size VME 5-slot horizontal mounting chassis. Accepts one or two sampling modules, one spare slot.

2000BR Rackmount – Standard size VME 5-slot horizontal rackmount. Accepts one or two sampling modules, one spare slot.

2000RH1 Rackmount – Standard size VME 12-slot horizontal rackmount. Accepts up to six sampling modules, four spare slots.

2000RV1 Rackmount – Standard size VME 10-slot rackmount. Accepts up to six sampling modules, two spare slots.

2000RV2 Rackmount – Standard size VME 20-slot rackmount. Accepts up to twelve sampling modules, four spare slots.

Computer Interfaces – IEEE-488.2 (GPIB); 2 each RS-232C; VME (Optional).

PHYSICAL CHARACTERISTICS

	B	BR	RH1	RV1	RV2
Dimensions	**in.**	**in.**	**in.**	**in.**	**in.**
Width	20	19	19	19	19
Height	7.4	7.4	14	17.5	17.5
Depth	19	19	21	26	26
Weight	**lb**	**lb**	**lb**	**lb**	**lb**
	31	31	40	35	48

POWER REQUIREMENTS
Voltage Range – 90 to 132 VAC or 180 to 250 VAC.

Line Frequency – 50 Hz to 60 Hz.

SYSTEMS
2000B Portable Benchtop System/2000BR Rackmount System:
- 1 – 2000B Chassis
- 2 – 4, 8, and 16 Channel Sampling Modules or
- 2 – High Throughout Sampling Modules
- 1 – 2000T Timing Module
- 1 – 2000P Processor Module
- 1 – 2000SS2 2 GS/s Splitter
- 1 – 2000 DMI Monitor
- 1 – 2000MC Mouse

2000RH1 Rackmount System:
- 1 – 2000RH1 Chassis
- 6 – 4, 8, 16 Channel Sampling Modules or
- 4 – High Throughput Sampling Modules
- 1 – 2000T Timing Module
- 1 – 2000P Processing Module
- 4 – Spare Slots Remaining

2000RV1 Rackmount System:
- 1 – 2000RV1 Chassis
- 6 – 4, 8, and 16 Channel Sampling Modules or
- 4 – High Throughout Sampling Modules
- 1 – 2000T Timing Module
- 1 – 2000P Processor Module
- 2 – Spare Slots Remaining

2000RV2 Rackmount System:
- 1 – 2000RV2 Chassis
- 6 – 4, 8, and 16 Channel Sampling Modules and
- 4 – High Throughout Sampling Modules or
- 12 – 4, 8, and 16 Channel Sampling Modules or
- 8 – High Throughout Sampling Modules
- 2 – 2000T Timing Modules
- 2 – 2000P Processor Modules
- 4 – Spare Slots Remaining

Analytek Waveform Capture Systems

Modules

2000P Processor Module

- Supports Up To 6 Sampling Modules and Corresponding Timing Module
- Provides Local Instrument Control, Waveform Display and Analysis

Characteristics (2000P)

The Processor Module provides the control and processing for one 2000T Timing Module and up to six Sampling Modules. The Processor Module is based on a fast, 32-bit CPU with accompanying floating-point processor and fast memory. On-board processing also supports local viewing and analysis of waveform data. It provides instrument control, via a Hercules compatible monitor and a mouse interface. The Processor Module has built-in routines for setting data conditions. Optional routines include:

- Finite impulse response (FIR) programmable low pass filter
- Sin(x)/x interpolation algorithm
- Signal integration
- Signal averaging

The Processor Module uses data correction algorithms, which are applied to data generated from the acquisition units (except for High Throughput Module where correction is done in the 2004HA Accelerator Module and not in the Processor). One 2000P Processor Module is required for each 2000T Timing Module and the accompanying (1-6) Sampling Modules.

Packaging – Single width standard size VME module.

Nominal Power – 40 W.

2000T Timing Module

- Supports Up To 6 Sampling Modules
- Source of Clocking & Triggering for Sampling Modules
- Multiple Acquisition Rates (1 MS/s to 2 GS/s)

Characteristics (2000T)

A single Timing Module is required for each unique group of 1 to 6 sampling modules. The Timing Module provides the acquisition rate clocking signal, the waveform triggering, and the AC calibration source signal.

Internal Clock – 1 GHz maximum, programmable rates, stability ±0.01%. Clock signal output is available as ECL level from 50 Ω.

Internal Clock Range – 1 MHz to 1 GHz in 200 steps.

External Clock – 1 GHz maximum. 1 V peak to peak nominal, AC coupled, 50% duty cycle into 50 Ω.

External Clock Accuracy – (Required for specified operation) ±0.01%.

Clock Dividers – (For internal or external clock). Allows setting of a wide range of sample intervals and delays.

Gated Clock Input – TTL high input enables External Clock.

External Arm – TTL high enables Trigger Circuit.

External Trigger Input – ±2.5 V programmable for level and slope: Resolution: 19.5 mV Accuracy: ±35 mV Slope: Positive or Negative.

Trigger Modes – Free-run, External, and Single-Shot.

Trigger Delay – Time (in sample intervals) –32 clock cycles from trigger event until it becomes effective.

Trigger Out Signal – Buffered ECL level output (high=true) synchronized to sample clock. High True level remains until ready to accept next trigger.

Packaging – Single width standard size VME module.

Nominal Power – 23.5 W.

2000IRG IRIG TIMING MODULE

The IRIG Timing Module provides data time-stamping to IRIG-A or IRIG-B standards for one or several time-coordinated Series 2000 Sampling systems.

2000TD Timing Distributor

- Distributes Gated Clock Signals to up to Six Sampling Modules
- Source of Triggering for Sampling Modules

Characteristics (2000TD)

The 2000TD Timing Distributor Module is designed to provide sampling clock signals for up to 6 Series 2000 Sampling Modules via the P2 VME backplane. The 2000TD is intended for applications which require a complex sampling clock pattern supplied from an external source in order to either synchronize data acquisition in large multichannel systems or to provide for complex sampling patterns for large and small data acquisition systems.

The 2000TD provides many of the functions of the 2000T Timing Module except for the generation of internal clock signals and trigger logic support. Clock signals and trigger logic are supplied by the 2000GC Gated Clock Module.

Compatibility and System Requirements:
The 2000TD must run under the control of a 2008GC Gated Clock Module, and each subsystem must include a 2000P Processor Module. Each subsystem may support up to six standard sampling modules or three high throughput sampling sets. The 2000TD is built on a 6U VME Eurocard.

2008GC Gated Clock

- Timing Control for up to Eight Sampling Stations

Characteristics (2008GC)

The 2008GC Gated Clock Module provides higher-level timing control for up to eight separate Series 2000 Data Acquisition Systems. The sampling rate for each contiguous sampling interval in a sequence is separately programmable, as is the time between successive segments. Clock gates to each subsystem may be delivered simultaneously, or delayed one with respect to another to capture a sequence of data segments involving variable sampling rates, record lengths, trigger options and number of channels taking data.

Compatibility and System Requirements:
When operating one or more Series 2000 Sampling subsystems under the hierarchical control of a 2008GC, the 2000T in the sampling subsystems is replaced with a 2000TD Timing Distributor Module. Under this mode of operation the master clock is provided by the 2008GC and the function of the 2000TD is to distribute the master clock signals to the sampling subsystem in good order. The 2008GC is built on a 6U Eurocard VME format, and is compatible with any VME module that does not employ the P2 connection in a conflicting fashion.

Analytek Waveform Capture Systems

Modules

2004S, 2008S, 2016S and 2004HS Sampling Modules:

- 500 MS/s Max Sample Rate (2004S & 2004HS)
  250 MS/s Max Sample Rate (2008S)
  125 MS/s Max Sample Rate (2016S)
- Up to 2 GS/s with Signal Splitter (2004S & 2004HS only)
- Up to 4 Channels per Module (2004S & 2004HS)
  Up to 8 Channels per Module (2008S)
  Up to 16 Channels per Module (2016S)
- 300 MHz Analog Bandwidth (150 MHz with 2008S)
- 12 bit Vertical Resolution
- Patented VLSI Analog Memory
- 10.5 Bits Dynamic Range
- 8K Acquisition Memory per Module (2K/Channel with 2004S & 2004HS) (1K /Channel with 2008S) (0.5K/Channel with 2016S)

2004HS High Throughput Sampling Module

- Throughput of 440 Waveforms/sec. (at 8K Points/Waveform)
- Short Cycle Capability for Shorter Record Lengths (e.g., 2,300 Waveforms/sec. at 1K points/waveform)

Characteristics (2004S, 2008S, 2016S, and 2004HS)

Sampling modules are available in either 4 channel (2004S), 8 channel (2008S), 16 channel (2016S), or 4 channel high throughput (2004HS) configurations.

Input Channels – SMA (LEMO on 2016S) connectors.

Input Range – Full Scale 1.0 Volt (0 ±0.5 V) with a ±950 mV offset capability. DC offset can be set on each channel.

ΔVDC Accuracy – ±0.5% Full Scale ±0.2% of Signal after auto-calibration.

Offset Accuracy – ±0.5% Full Scale ±0.5% of Offset after auto-calibration.

Input Bandwidth (–3 dB) – 300 MHz.

Input Impedance and Coupling – 50 Ω DC Coupled.

ADC – 12 bits providing resolution of 1 part in 4096.

Dynamic Range – ≥60 dB.

Record Length –

Module	Operating Mode (Post Trigger)	Waveform Data Samples Each Channel
2004S	4 Channels	2048
2004HS	2 Channels	4096
	1 Channel	8192
2008S	8 Channels	1024
2016S	16 Channels	512

Signal Output – Signal output from CH 1 of each module is available for trigger signal to 2000T Timing Module or as signal conditioning for other instrumentation.

Auto Calibration – Provides AC (signal from Timing Module), DC, and Baseline Calibration.

Packaging – Single width standard size VME module.

Nominal Power – 45 Watts per Sampling Module.

2004A Amplifier Attenuator

The Amplifier-Attenuator Module can be installed in any unused slot in a Series 2000 Chassis. The module can also be used independently of the Series 2000 architecture, in any standard size VME chassis.

Characteristics

Inputs – 4 Channels @ 50 Ω or 1 MΩ, BNC connectors.

Gain – 1, 2, 5, or 10x.

Attenuation – 1, 2, 5, 10, 20, 50, or 100x.

Gain/Attenuation Accuracy – ±1% at DC.

Band Flatness – ±1 dB from 0 to 400 MHz for 50 Ω inputs.

Outputs – 4 Channels into 50 Ω, SMA connectors.

Output Level – 2 Vp-p <1% distortion; 4 Vp-p <2% distortion.

Noise – 5 nV/sqrt Hz (110 μV rms R.T.I.).

Offset Capability – ±2x full scale.

Bandwidth – 0 to 400 MHz, 50 Ω; 0 to 200 MHz, 1 MΩ.

Maximum Input Levels – 50 Ω inputs –0.5 Watts continuous; 100 V peak, 100 μS; 1 MΩ inputs, 10 Vp-p.

Calibration – Built-in AC calibration source; DAC controlled DC calibration source.

VME Interface – Standard data interface.

Nominal Power – 35 Watts per module.

Series 2000 Signal Splitters

These signal splitters and appropriate time delays adapt a 2004S sampling module to a variety of system sampling rates, record lengths and numbers of channels. One splitter is required for each sampling module.

Signal Splitter	Number of Channels	Sampling Rate	Word Length
2000SS1	2	1 GS/s	4K
2000SS2	1	2 GS/s	8K
2000SS3	1	1 GS/s	8K
2000SS4*1	2	500 MS/s	4K
2000SS8*1	1	500 MS/s	8K

**1 Sampling rate is programmable from 1 MS/s through 500 MS/s*

Analytek Waveform Capture Systems

2000 Series Fast Cache Memory

- Available in 8, 16, 32 and 64 Megabyte Capacity
- Single-Width Standard VME Package

Series 2000 dual-ported cache memory modules contain their own address register and each port is separately buffered for total compatibility with the **VMEbus** specification (Rev.C.1) and **VSBus** specification (Rev. c). These modules may therefore reside in any standard Series 2000 slot (i.e., any slot not designated for a Series 2000 sampling module) or in any chassis employing the VMEBus or VSBus backplanes. VMEBus Options D32, D16, and D8 (32, 16, and 8-bit data path width) and A32, A24 (32 and 24 bit address path width) are incorporated as standard features.

Cache Memory Module	Description
2002MI	Cache Memory Interface Module
2008MM	8 Megabyte VME Cache Memory
2016MM	16 Megabyte VME Cache Memory
2032MM	32 Megabyte VME Cache Memory
2064MM	64 Megabyte VME Cache Memory
2000CBM	Cable Memory Interface Cable

2002MI VME Cache Memory Interface: The 2-channel Cache Memory Interface accepts data from either one or two 2000HA Accelerator Modules and transfers the data to one or more Cache Memory Modules via the VME Subsystem Bus (VSBus). Per-channel data transfer rates up to 5 megawords per second (10 megabytes per second) are achievable.

2000BBM Battery Backed-up Memory Module: The Memory Module provides 1 megabyte of battery back-up static RAM via an on-board lithium battery. Write and read access times are 70 ns and 200 ns respectively. Write protection switches and a RUN/LOCAL switch for the VME bus interface are provided.

Nominal Power – 17 W.

2000AM Air Management Module: Adequate cooling of the Series 2000 modules is necessary for proper operation. The maintenance of proper cooling air flow and signal continuity requires the use of a 2000AM air management module in any otherwise unoccupied slot in a Series 2000 chassis.

2000DM1 Monitor: 14-inch monochrome Hercules-compatible display monitor for waveform viewing and instrument control.

2000MC Mouse: Serial Mouse interface device for use with the 2000DM1 display monitor.

2032LC General Purpose Module

The 2032LC is a general purpose 1 to 32 channel sampling module optimized for data logging and transient signal capture. Typical applications include particle accelerator instrumentation and similar distributed instrumentation and control applications. The 2032LC accepts 32 discrete differential analog inputs, converts the signals to digital format, autocorrects and stores the data in local memory. The module achieves 15 bits of dynamic range with a proprietary Analytek Analog Sampling Array (ASA) operating in a dual-range mode and using a 12-bit on-board analog-to-digital converter. Input bandwidth is 30 kHz, and input impedance is 800 kΩ differential or 400 kΩ common mode.

Sample rate of the 2032LC is programmable to 10 kS/s maximum per channel when configured as a full 32 channels per module, and increased sample rates are available if the module is configured to operate fewer channels. The standard 1 Mword of on-board memory is sufficient to store one second worth of data at the maximum sample rate. Optional memory expansion to 2 Mwords is available.

COMPATIBILITY AND SYSTEM REQUIREMENTS

The 2032LC is a self-contained general-purpose sampling module with on-board timing and programmable trigger circuitry. The sample clock may be internally-generated, or an external sample clock may be accepted via a front-panel port. Similarly, the trigger may be internally-generated, or an external system trigger may be furnished. Additionally, the internally-generated signal may be made available through the front panel for external system synchronization.

The 2032LC accepts control inputs from any standard VME processor employing register-based commands over the VME backplane. A "C" language software driver is provided as standard equipment with each unit. The module is built on the 6U VME Eurocard format. Front panel connectors are LEMO type 00 female connectors and no optional connectors are available.

Note specifically that the 2032LC is self contained and is not designed to be used in conjunction with the 2000T, 2004S, 2008S, or 2016S Standard Waveform Sampling Modules, or with the 2004HS1 or 2004HS2 High Throughput Waveform Sampling Systems. Both the VME P1 and P2 plugs of the 2032LC adhere to VMEbus standard specifications with no pins dedicated for special functions. All Series 2000 VME chassis will accept 2032LC modules.

Characteristics (2032LC)

Inputs – 32 differential, maximum. Programmable from 1 to 32, starting at CH 1.

Input Range/Offset – 10 V Full scale. Adjustable (0-Voff) to (10-Voff). All channels have same range.

Sample Rate – 10 kS/s maximum. Programmable 1 S/s to 10 KS/s in 1-2-5 steps.

Input Impedance – 800 kΩ differential; 400 kΩ common mode.

Input Bandwidth – 30 kHz.

Input Protection – ±500 V differential or common mode.

Common Mode Range – ±200 V.

Measurement Resolution – 12 bits, 1/4096, 0.025% of reading @ FS; 9 bits, 1/512, 0.2% of reading @ 1/8 FS + DV; 12 bits, 1/4096, 0.025% of reading @ 1/8 FS-DV; Above at zero volts offset. As offset changes, high-sensitivity range tracks with offset.

Measurement Accuracy – DC accuracy past input buffer can be calibrated to resolution of the ADC. Input buffer limits accuracy to ±0.05% and offset to ±1 mV.

Dynamic Range – 15 bits in two ranges, using 12 bit ADC.

Sample Jitter & Skew – ±5 nsec w.r.t. sample clock.

Memory – 1 Mwords minimum; 2 Mwords optional.

Analytek Waveform Capture Systems

ORDERING INFORMATION

2000B
Benchtop 5-slot horizontal chassis **$4,500**

2000BR
Rackmount 5-slot chassis **$4,500**

2000RH1
Horizontal 12-slot chassis **$6,500**

2000RV1
Vertical 10-slot rackmount chassis **$7,350**

2000RV2
Vertical 20-slot rackmount chassis **$9,000**

2004S
Sampling Module 4 channel **$9,950**

2008S
Sampling Module 8 channel **$13,950**

2016S
Sampling Module 16 channel **$16,950**

2032LC
Gen'l Purpose Sampling Module - 1 Mword **$9,295**

2032LC
Gen'l Purpose Sampling Module - 2 Mword **$9,995**

2004SC
High Throughput Sampling Module **$9,950**

2000HA
Accelerator Module **$8,950**

2004HS1
High Throughput Sampling Subsystem **$18,900**

2004HS2
High Throughput Sampling Subsystem **$27,450**

2004A
Amplifier-Attenuator Module **$4,995**

2000T
Timing Module **$3,395**

2000TD
Timing Distributor Module **$2,795**

2008GC
Gated Clock **$5,995**

2000IRG
IRIG Timing Module **$3,495**

2000P
Processor Module **$5,995**

2000SS1
1 GS/s Signal Splitter **$700**

2000SS2
2 GS/s Signal Splitter **$700**

2000SS3
1Gs/s, 8k Signal Splitter **$700**

2000SS4
4K Signal Splitter **$700**

2000SS8
8K Signal Splitter **$700**

2000BBM
Battery Backed-up Memory Module **$2,195**

2002MI
2-Channel VME Cache Memory Interface **$3,495**

2008MM
8 Megabyte Cache Memory **$2,995**

2016MM
16 Megabyte Cache Memory **$4,195**

2032MM
32 Megabyte Cache Memory **$5,995**

2064MM
64 Megabyte Cache Memory **$12,995**

2000PDA
High Capacity Parallel Disk Array *1

200PTD
High Capacity Parallel Transfer Disk system *1

2000PDI
High-speed Disk Interface Module *1

2000CBM
Cache Memory Interface Cable 2000HA to 2002MI **$89**

2000CBI
Cache Memory Interface Cable 2000HA to 2004PDI **$119**

2000CBR
Custom Ribbon Cable *1

2000DM1
14 in. Mono. Monitor **$250**

2000MC
Serial Mouse **$200**

2000AZ1
Interactive Measurement System Software **$795**

2000CS
Control & Calibration Software **$3,495**

2000CV1
5-slot Backplane Conversion Kit **$2,995**

2000CV2
10-slot Backplane Conversion Kit **$4,495**

2000AM
Air Management Interface Module **$79**

INTERNATIONAL POWER PLUG OPTIONS
Opt. A1 - Universal Euro 220 V, 50 Hz ..... **NC**
Opt. A2 - United Kingdom 240 V, 50 Hz ..... **NC**
Opt. A3 - Australian 240 V, 50 Hz ..... **NC**
Opt. A4 - North American 240 V, 60 Hz ..... **NC**
Opt. A5 - Switzerland 220 V, 50 Hz ..... **NC**
See General Customer Information Section for additional description.

WARRANTY
The Analytek 2000 Series carries a standard Tektronix 1-year warranty covering labor and replacement parts.

ACCESSORIES
See Accessories section for complete line of compatible accessories.

ADDITIONAL INFORMATION
For additional information, contact the Tektronix Sales Office nearest you at:

(800) 835-9433 ext. 170 or
Analytek, Ltd.
365 San Aleso Avenue
Sunnyvale, CA 94086
(800) 366-5060
(408) 745-1114
Fax (408) 745-1894

Tektronix, Inc. has a non-exclusive distribution agreement with Analytek, Ltd.

*1 *Contact Analytek for price information.*

GPIB IEEE-488 — The Analytek 2000 Series of Digitizers complies with the IEEE Standard 488.2 and Tektronix Codes and Formats.

Logic Analyzers
& Digital Analysis Systems

Tektronix offers a wide variety of products to support system analysis of large complex systems (DAS 9200), general purpose logic analysis of medium sized designs (3000 Series), and the 1230 for low end designs and educational settings.

DAS/SE Digital Analysis System

The DAS/SE digital analysis system is the un-rivaled performance leader in analysis of complex digital systems. Now with super deep memory of up to 512K bits per channel, up to 1536 channels of 100 MHz synchronous acquisition, pattern generation, high speed timing, support for multiple microprocessors, the most intelligent disassembly available, links to high level debug tools and languages, and networked to your X-Window Based workstation for easier and faster operation.

LV500 Verification System

The LV500 Verification system for ASICs & boards offers a compact, easy to use, and low cost system that engenders the best of logic simulators and large production testers. The LV often saves ASIC and board turns, paying for itself several times over. Flexible timing control, deep patterns, and expandability make the LV500 a powerful engineering verification tool.

3000 Series GPX Logic Analyzer

NEW this year in the 3000 Series is the GPX Logic Analyzer. The GPX, with 8 tools in one module, offers an outstanding value in a general purpose logic analyzer. In addition, the GPX supports today's leading microprocessors, including the 50 MHz 486, in three different mainframe configurations. Other cards add a digital oscilloscope, high speed timing analyzer, and speciality microprocessor support capabilities.

1230 Configurable Logic Analyzer

The 1230 offers you the lowest entry price of any configurable logic analyzer, and is expandable with up to 4 logic analysis or digital oscilloscope cards. A complete logic analysis training package makes the 1230 an excellent choice for educational settings, or for first time logic analyzer users. Despite the low cost of the 1230, it still offers Tektronix qualities such as powerful triggering, GPIB, powerful disassembly, and ease of configuration.

CONTENTS

LOGIC ANALYZERS

Overview....152
Microprocessor Support....155
DAS/SE Digital Analysis System....158
LV500 Verification System....166
3000 Series Logic Analyzers....168
1230 Series Logic Analyzers....178
Probes and Leadsets....183

Logic Analyzers
& Digital Analysis Systems

Performance leader in Logic Analysis.

DAS9200/SE DIGITAL ANALYSIS SYSTEM

- The Unrivaled Performance Leader in Analysis of Complex Designs

LV500 VERIFICATION SYSTEM

- Compact
- Easy to Use
- Low Cost System for Logic Simulation and Production Test

3000 SERIES LOGIC ANALYZERS

- Best Value
- Comprehensive Microprocessor Support
- Portable and Benchtop Configurations

1230 SERIES LOGIC ANALYZERS

- Low Cost
- Configurable
- Expandable
- Up to Four Logic Analysis or Digital Oscilloscope Cards

Tektronix is the performance leader in logic analysis. Our products are different from others on the market in fundamental and important ways. Our logic analyzer products embody our beliefs about how to design, manufacture, and market logic analyzers to achieve long term customer satisfaction.

Banner specs are necessary, but not sufficient, to ensure getting your job done. We want you to know as much as possible about our logic analyzers and digital analysis systems before deciding whether our products fit well into your evolving digital design needs. This section contains important introductory information about Tektronix logic analyzers.

VLSI Integration for High Performance and Low Cost

We utilize VLSI in our products in a unique way. One fundamental question is whether to 'horizontally' integrate an 'LA on a chip'... that is several full channels of logic analysis onto an ASIC, or to integrate 'vertically'... by putting one function for all channels, such as clocking or triggering, or memory, into an ASIC.

The former choice yields the lowest cost per channel, but limits performance and enhancibility. The latter approach, if well implemented, offers unmatched performance but economies of scale are lower.

Our approach at Tektronix is to use each architecture where appropriate.

In our Digital System Analysis products we make no trade off which will compromise system capability. In our logic analyzer lines we use LA-on-a-chip architectures which meet the cost per channel goals of mid range users. In every case we keep memory off chip to allow memory depth scalability. Our VLSI integration is state of the art, allowing us to offer acquisitions systems that are affordable and fast enough to keep up with today's technology.

Probing for Ease and Accuracy

Probes are the highest volume component in a logic analyzer, and if they are quality probes they represent a large fraction of the total cost. No component is more critical to long term end user satisfaction, since the probes are a major factor in both ease of use and high performance acquisition.

Probing quality varies greatly among analyzers on the market today. There is little in common between an inexpensive woven ribbon cable, and precision NiCR Coax with 7 component passive hybrids embedded in each podlet. The former may cost less, but will experience cross talk, provide inadequate grounding performance, and present a real EMI hazard.

Another fundamental capability is single probing for timing and state. Do not confuse claims of 'dual acquisition per point' with single probe state and timing simultaneous acquisition, even for high end microprocessors.

Tektronix' LASI-3 (logic analyzer standard interface) probing standards enforce strict mechanical and electrical performance standards. When we design probing for a 325 pin PGA we design in the same high signal integrity features we use on an oscilloscope probe.

State-of-the-Art Microprocessors Require Powerful Clocking

A few short years ago acquiring data from a microprocessor was not much different than acquiring data from digital sources in general. With today's microprocessors employing such complex bus & clocking schemes, other logic analyzer vendors put a variety of logic, including latches, on their microprocessor probes to sort out what to acquire and when. These are called 'preprocessors'.

We believe an inherently better approach to complex clocking needs is to find a way to keep latches off the probe, thus allowing timing and state data to be acquired simultaneously through the same probe. To do this we have implemented a series of hardware and software tools that allow the clocking behavior of any microprocessor to be modeled in a software controlled state machine built into each logic analyzer. This proprietary clocking state machine is closely coupled to software tools that allow us to quickly build clocking and disassembly support for the most complex micros, and without hardware on the probe to interfere with timing acquisitions.

Logic Analyzers
& Digital Analysis Systems

Triggering is Key

The most fundamental distinction between having good banner specs and being able to solve real problems is in the area of triggering. Logic analysis triggering is a classic example of what at the surface can appear to be an inevitable trade off between power and ease of use. Tektronix has developed a fresh approach to this area and has achieved unequaled capabilities, while maintaining ease of use.

We use a patented triggering state machine architecture that provides a rich triggering toolset. We combine the versatility of the true state machine triggering with extensive predefined libraries, and also provide the option of modifying the library.

'Level oriented' trigger paradigms are confining, difficult to drive, and often lack the horsepower to describe the unique symptom you wish to trigger on. Yet 'levels' cost much less than states to provide. As a general rule one state equates to several levels in raw triggering power, and is much easier to use. An excellent exercise when choosing a logic analyzer is to develop a realistic trigger set up for your expected needs. The difference between a 'state' and a 'level' will become quickly apparent.

Memory Depth... Link Between Symptom and Cause

In most situations logic analyzers are set up to trigger on a visible symptom of a problem. With microprocessor based designs the cause of the problem is often separated from the symptom by a lot of bus activity and long periods of time.

We believe a most important but often least considered spec for a logic analyzer is the memory depth. It is most often the constraining factor on end users, and it is why we are committed to scalable designs.

Your needs may increase over time, and our designs will not be constrained by trade offs made in chip set architecture, power per slot, cooling, etc. Some analyzers on the market today embody tradeoffs made on memory depth that we consider unacceptable, such as memory vs. timestamp and glitch capture. We are committed to offering deep memory and powerful data qualification features to help you solve real problems.

Disassembly... Much More Than Inverse Assembly

In years past if one had state data off a microprocessor bus it was possible to simply look up instruction mnemonics in a table ('inverse assembly') with good results.

Today's micros include pipelines, prefetch queues, caches, and other architectural structures that have created a many-to-one relationship between bus activity and object code. A look up table approach is now totally inadequate.

Tektronix offers disassemblers that intelligently predict branches, queue flushing, and other microprocessor specific operational idiosyncrasies. Our disassemblers also support modes of data display configurable for individual needs with varying levels of data & control flow abstraction.

Tektronix is committed to providing a complete spectrum of microprocessor support with low cost, simple solutions all the way through complete intelligent disassemblers. We will provide a full suite of support hardware and software with these packages, including excellent manuals, reference memories, sockets, probes, set up and clocking files, and application engineering support.

Digital System Analysis

General purpose logic analysis is one activity, and detailed analysis of complex digital systems is another. In the latter a richer suite of hardware and software tools are needed, including support for high level language debug tools, very deep memories, networking, hosting on workstations, multi-analyzer/multi-microprocessor support, integrated pattern generation & high speed timing analysis, tight correlation of data, and more. We believe customers with these needs should have access to:

1. Symbol support that displays high level symbols, such as subroutine name calls, in disassembly listings.
2. Abstraction modes of display that allow views of prototype activity including high speed timing analysis, state analysis, hardware bus disassembly, software disassembly, control flow trace, subroutine trace, and graph mode.
3. Performance analysis for software optimization, including real time performance analysis.
4. LA Connect, a program of linkage with the most popular high level language development tools that gives you a complete debug environment.
5. Workstation hosted user interfaces, LAN capability, hard disk and compatible floppy storage, and a high speed application bus for tight intermodule coupling.
6. Super deep acquisition memories with no trade offs between depth and other functions.

System Architectures... Adequate Resources for Solving Complex Problems

Lowering initial purchase price slightly in a way that escalates long term cost of ownership is not an acceptable trade off to us. We put the appropriate system resources where they need to be from the beginning.

In particular system architecture should include hard disk, compatible floppies, enough system RAM to handle system upgrades, a high-speed bus for module interconnection, support for large color monitors, enough slots and power per slot to support system growth, and expansion mainframes.

Also important to us are inclusion of related measurement performance such as pattern generation, high speed timing, and oscilloscopes. Finally, we believe in user configurable modularity. All our logic analysis products are user configurable to protect your investment over time.

Logic Analyzers
& Digital Analysis Systems

Specifications

Unlike oscilloscopes, logic analyzer performance to specification may not be readily visible to the user. We have invested in a unique, ultra high performance logic analyzer test station called Gunnar.

We test every design, and every analyzer off the production line, to insure full performance across the range of channel count, bandwidth, logic swing, and setup/hold time. A Tektronix specification errs on the side of understatement. We will spec at the probe tip, not the BNC. And we will stand behind the specs.

We now offer a simple low cost verification fixture (CENTRAK) which can help you determine the quality of an analyzer before you decide which one to purchase.

Support

Tektronix wants to please customers not only for the first 30 minutes, but over the long term. Our logic analyzers are supported by a staff of field specialists and applications engineers, as well as by toll free telephone hotline support. Our manuals are complete and consistent, and we have a wide library of support and application notes.

Our accessories include what it takes to get the job done. We include appropriate items such as ZIF sockets, refmems, and leadsets to help insure you will not face unplanned delays.

Logic Analyzer Selection

Banner specifications are necessary, but not sufficient, indicators of how well a logic analyzer will meet your digital debug needs. We recognize this and appreciate how difficult it is to extract second tier performance measures from the available literature on some of today's logic analyzers. Some specification sheets omit key performance measures, while others decimate an indicator into several cryptic sub-specifications masking true performance. Often specifications are inter-related and inter-dependent, yet this is not clear from the literature.

To help you avoid unpleasant surprises Tektronix offers complete specifications on our own products, and also maintains a comparative data base on major logic analyzer products available today.

We can help you ask the right questions and normalize the answers. Our sales and applications specialists will be able to help you make the most informed choice possible. Following are some questions you should ask in considering a logic analyzer:

- Is it configurable by the user?
- Are the banner specs mutually exclusive (i.e. when you turn on one function, do you give up another?)
- Is functionality such as oscilloscope, high speed timing, pattern generation, ROM emulation, and links to high level languages and debug tools available?
- Can the probing system handle simultaneous, single probing acquisition of timing and state data?
- What is the 'granularity' of channel assignments? This is important since 80 channels with low granularity and simultaneous state and timing will offer more utility than 100 channels with poor granularity.
- What is the actual size of the display? Is all of it usable? This is important since disassembly displays for complex micros need a full size display for easy reading.
- Is it a system, or only a modular mainframe? For example is tight coupling between cards provided? Is welding provided? Is a common user interface provided, or only common user interface hardware?
- Is adequate system storage available? Are the floppies DOS compatible? Is the hard disk large enough?
- Is there a LAN? GPIB? Postscript support?
- Can the sales engineer show me a sample trigger program that would actually work in a realistic problem you are likely to encounter?
- Is the disassembly full featured?
- Is the probing a likely source of EMI?

Microprocessor Support Chart

MICROPROCESSOR SUPPORT SELECTION GUIDE

Microprocessor Type & Package	DAS 9200 92A96/ D/XD/SD	DAS 9200 92A90/D	PRISM 3000 GPX	PRISM 3000 MPX	1230
AMD					
AM80386DX QFP-132 (soldered)			√		
29000 PGA-169 (socketed)	√				
29050 PGA-169 (socketed)	√				
CYPRESS SEMICONDUCTOR					
CY7C601 Sparc PGA-208 (socketed)	√				
FUJITSU					
MB86903 Sparc PGA-208 (socketed)	√				
INTEL					
8031 DIP-40 (soldered)	√	√	√	√	
8031 DIP-40 (socketed)	√	√	√	√	√
8031 PLCC-44 (socketed)	√	√	√	√	
8032 DIP-40 (soldered)	√	√	√		
8032 DIP-40 (socketed)	√	√	√	√	√
8032 PLCC-44 (socketed)	√	√	√	√	
8051 DIP-40 (soldered)	√	√	√	√	
8051 DIP-40 (socketed)	√	√	√	√	√
8051 PLCC-44 (socketed)	√	√	√	√	
8052 DIP-40 (soldered)	√	√	√	√	
8052 DIP-40 (socketed)	√	√	√	√	√
8052 PLCC-44 (socketed)	√	√	√	√	
80C152 DIP-48	√	√	√	√	
80C152 PLCC-68 (socketed)	√	√	√	√	
80C452 PLCC-68 (socketed)	√	√	√	√	
80515 PLCC-68 (socketed)	√	√	√	√	
80532 PLCC-68 (socketed)	√	√	√	√	
80535 PLCC-68 (socketed)	√	√	√	√	
83C152 DIP-48	√	√	√	√	
83C152 PLCC-68 (socketed)	√	√	√	√	
83C452 PLCC-68 (socketed)	√	√	√	√	
83C537 PLCC-84 (socketed)	√	√	√	√	
8096 PLCC-68 (socketed)					√
80C196 PLCC-68 (socketed)					√
8085 DIP-40 (soldered/socketed)	√	√	√		√
8086 DIP-40 (socketed)		√	√	√	√
80C86 DIP-40 (socketed)		√	√	√	√
8088 DIP-40 (socketed)		√	√	√	√
80C88 DIP-40 (socketed)		√	√	√	√
80186 PGA-68 (socketed)		√	√	√	√
80186 LCC-68 (socketed)		√	√	√	
80186 PLCC-68 (soldered/socketed)		√	√	√	
80C186 PGA-68 (socketed)		√	√	√	√
80C186 LCC-68 (socketed)		√	√	√	
80C186 PLCC-68 (soldered/socketed)		√	√	√	
80188 PGA-68 (socketed)		√	√	√	√
80188 LCC-68 (socketed)		√	√	√	
80188 PLCC-68 (soldered/socketed)		√	√	√	
80C188 PGA-68 (socketed)		√	√	√	√
80C188 LCC-68 (socketed)		√	√	√	
80C188 PLCC-68 (soldered/socketed)		√	√	√	
80286 PGA-68 (socketed)		√	√	√	√
80286 LCC-68 (socketed)		√	√	√	
80286 PLCC-68 (soldered/socketed)		√	√	√	
80C286 PGA-68 (socketed)		√	√	√	√
80C286 LCC-68 (socketed)		√	√	√	
80C286 PLCC-68 (soldered/socketed)		√	√	√	
80376 PQFP-100 (socketed)	√	√	√	√	
80376 PQFP-100 (soldered)	√	√	√	√	√
80386SX PQFP-100 (socketed)	√	√	√	√	√
80386SX PQFP-100 (soldered)	√	√	√	√	
80386DX PGA-132 (socketed)	√	√	√	√	
80486SX PGA-168 (socketed)	√		√		
80486DX PGA-168 (socketed)	√		√		

MICROPROCESSOR SUPPORT:

- Symbolic Address Display
- Multiple Disassembly Formats
- Shows Which Instructions Were Executed
- Simultaneous State and Timing Analysis
- Time Correlated Displays
- Performance Analysis
- Superior Microprocessor Probing
- Multiple Microprocessor Analysis

Tektronix offers a wide range of microprocessor support.

Continued on next page.

Microprocessor Support Chart

PLEASE NOTE:
Support for new microprocessors is constantly being introduced and our support is continually expanding and being updated. Please consult your local sales engineer if the device or package that you are using is not listed.

Microprocessor Type & Package	DAS 9200 92A96/ D/XD/SD	DAS 9200 92A90/D	PRISM 3000 GPX	PRISM 3000 MPX	1230
80486DX-50 PGA-168 (socketed)	√		√		
80486DX2 PGA-168 (socketed)	√		√		
80487SX PGA-168 (socketed)	√		√		
80487DX PGA-168 (socketed)	√		√		
P5 PGA-273 (socketed)	√		√		
80960KA PGA-132 (socketed)	√				
80960KB PGA-132 (socketed)	√				
80960MC PGA-132 (socketed)	√				
80960CA PGA-168 (socketed)	√				
i860XR PGA-168 (socketed)	√				
LSI LOGIC					
64811 Sparc PGA-208 (socketed)	√				
MIPS (also Performance Semi, LSI Logic, IDT, Siemens, NEC & Toshiba)					
R3000 PGA-145 (socketed)	√				
R3400 PGA-145 (socketed)	√				
R3000A PGA-175 (socketed)	√				
R4000PC PGA-179 (socketed)	√				
R4000SC PGA-447 (socketed)	√				
R4000MC PGA-447 (socketed)	√				
MOTOROLA					
6800 DIP-40 (soldered/socketed)			√		√
6802 DIP-40 (soldered/socketed)			√		√
6805 DIP-40 (soldered/socketed)			√		
6809 DIP-40 (soldered/socketed)		√	√		√
6809E DIP-40 (soldered/socketed)		√	√		√
68HC11 PLCC-52 (soldered/socketed)	√*3	√*3	√	√	√
68HC16 QFP-132 (soldered)	√		√		
68302 PGA-132 (socketed)	√*1,*3	√*1,*3	√	√	
68302 QFP-132 (soldered)	√*3	√*3	√	√	
68331 QFP-132 (socketed)		√*3	√	√	
68332 QFP-132 (socketed)		√*3	√	√	
CPU-32 BCC		√*3	√	√*1	
68000 DIP-64 (socketed)	√	√	√	√	√
68000 PGA-68 (socketed)	√	√	√	√	√
68000 PLCC-68 (soldered)	√	√	√	√	
68000 PLCC-68 (socketed)	√	√	√	√	
68EC000 PLCC-68 (soldered/socketed)			√		
68HC000 PGA-68 (socketed)	√*3	√*3	√	√	√
68HC001 PLCC-68 (soldered/socketed)	√*3	√*3	√	√	√
68010 DIP-64 (socketed)	√	√	√	√	√
68010 PGA-68 (socketed)	√	√	√	√	√
68010 PLCC-68 (soldered)	√	√	√	√	
68010 PLCC-68 (socketed)	√	√	√	√	
68020 PGA-114 (socketed)	√	√	√	√	
68020 QFP-132 (soldered)			√		
68EC020 PGA-100 (socketed)			√		
68030 PGA-128 (socketed)	√	√	√	√	
68030 QFP-132 (soldered)			√		
68EC030 PGA-128 (socketed)	√	√	√	√	
68040 PGA-179 (socketed)	√		√		
68EC040 PGA-179 (socketed)	?		√		
68LC040 PGA-179 (socketed)	?		√		
88100 PGA-181 (socketed)	√				
88110 PGA-300 (socketed)	√*2,*3				
56000 PGA-88 (socketed)	√*3	√*3	√	√	
56000 QFP-132 (soldered)	√*3	√*3	√		
56001 PGA-88 (socketed)	√*3	√*3	√	√	
56001 QFP-132 (soldered)	√*3	√*3	√		

**1 Uses general purpose leads and commercial accessory (not available through Tektronix)*
**2 Probe adapter available through third party*
**3 Disassembly support available, but not sold as a formal product - contact sales representative for details*

Continued on next page.

Microprocessor Support Chart

Microprocessor Type & Package	DAS 9200 92A96/ D/XD/SD	DAS 9200 92A90/D	PRISM 3000 GPX	PRISM 3000 MPX	1230
(Motorola continued)					
56002 PGA-132 (socketed)			√		
56002 QFP-132 (soldered)			√		
96002 PGA-223 (socketed)	√	√			
TEXAS INSTRUMENTS					
TMS32020 PGA-68 (socketed)	√*3	√*3	√	√	
TMS32020 PLCC-68 (socketed)	√*3	√*3	√	√	
TMS320C25 PGA-68 (socketed)	√*3	√*3	√	√	
TMS320C25 PLCC-68 (socketed)	√*3	√*3	√	√	
TMS320C26 PLCC-68 (socketed)	√*3	√*3 √	√		
TMS320C30 PGA-181 (socketed)	√		√		
TMS320C31 QFP-132 (soldered)	√		√		
TMS320C40 PGA-325 (socketed)	√*2,*3		√*2,*3		
TMS320C50 QFP-132 (soldered)	√*3				
ZILOG					
Z80 DIP-40 (soldered/socketed)	√	√	√	√	√
OTHER					
6502/C02/802 DIP-40 (sold./sock.)					√
PACE 1750		√			
F9450		√			
MII-Std 1750A		√			
BUS Support					
IEEE-488 (GPIB)	√		√		√
STD Bus					√
Futurebus+	√				
VME	√	√*2			
ISA	√*2	√*2			
EISA	√*2	√*2			
Micro Channel	√*2	√*2			
RS-232	√	√	√	√	√
IDT					
R3051 PGA-88 (socketed)	√		√		
R3051 PLCC-84 (socketed)	√		√		
R3052 PGA-88 (socketed)	√		√		
R3032 PLCC-84 (socketed)	√		√		
R3081 PGA-88 (socketed)	√		√		
R3081 PLCC-84 (socketed)	√		√		

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PLEASE NOTE:
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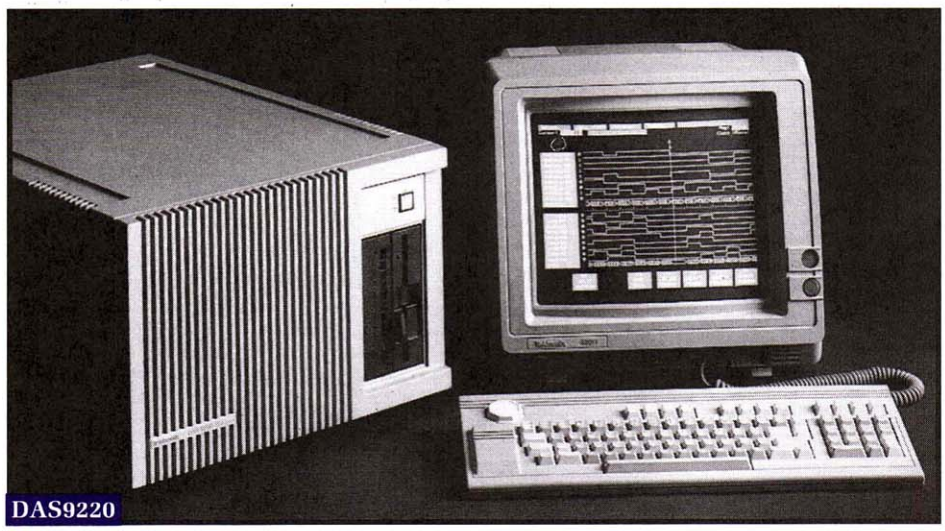
Digital Analysis System

New DAS/SE Mainframe.

DAS/SE

- Up to 1536 Channels with 10ns Resolution
- Up to 160 Channels with 500 ps Resolution
- More than 500 Channels of 100 MHz Pattern Generation
- Maximum Memory Depth of 512K
- Support for Many Popular Rise and Cisc Micro-processors
- Multiprocessor Support for up to 8 CPU's at Once



DAS9220

The System Challenge

The design and debug of new multiprocessor systems with faster clocks, wider buses, and larger memories is a difficult task to undertake. Complete solutions to these problems are hard to find, and integrating the pieces of a solution are almost impossible.

The 9200 Series Digital Analysis System (DAS9200) is a complete answer to the needs of design, debug, and test. The advanced architecture of the DAS9200 allows you to install all the data acquisition and pattern generation modules you need today without limiting your future demands. You can easily expand or reconfigure as your requirements change.

CONFIGURABLE INSTRUMENT FOR A BROAD RANGE OF APPLICATIONS

Multiple data acquisition and pattern generation cards can be added to a DAS9200 system. The cards you select can be grouped into subsystems, allowing you to create virtual instruments within the DAS. These separate instruments can be controlled independently to observe multiple circuits at once. You can also increase channel widths by grouping like cards into a larger virtual card.

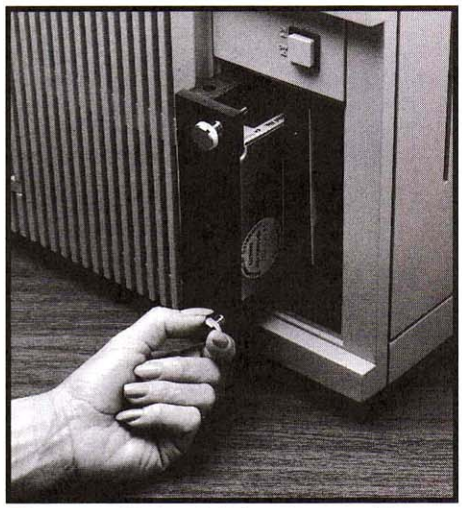
Cards can also interact in real time. For example, two acquisition modules running at different clock speeds can display the acquired data in a time-correlated format, simplifying the debug of multi-processor designs. Or an acquisition module could wait for a specific event and then start a pattern generator.

COMPLEX DESIGNS REQUIRE PROBING OF MANY SIGNALS

As digital designs become more complex, more signals in the SUT need to be observed to ensure proper operation. To probe those signals, a adequate number of acquisition channels must be available. Having almost enough channels means limiting data acquired, re-probing, or reacquiring data.

Viewing the whole problem in context is the reason for a digital analysis system. But along with channel count, you require greater measurement performance and the ability to display the data in a intelligible format. The DAS9200 display is designed to display large amounts of acquired data with powerful search, format, and symbol capabilities.

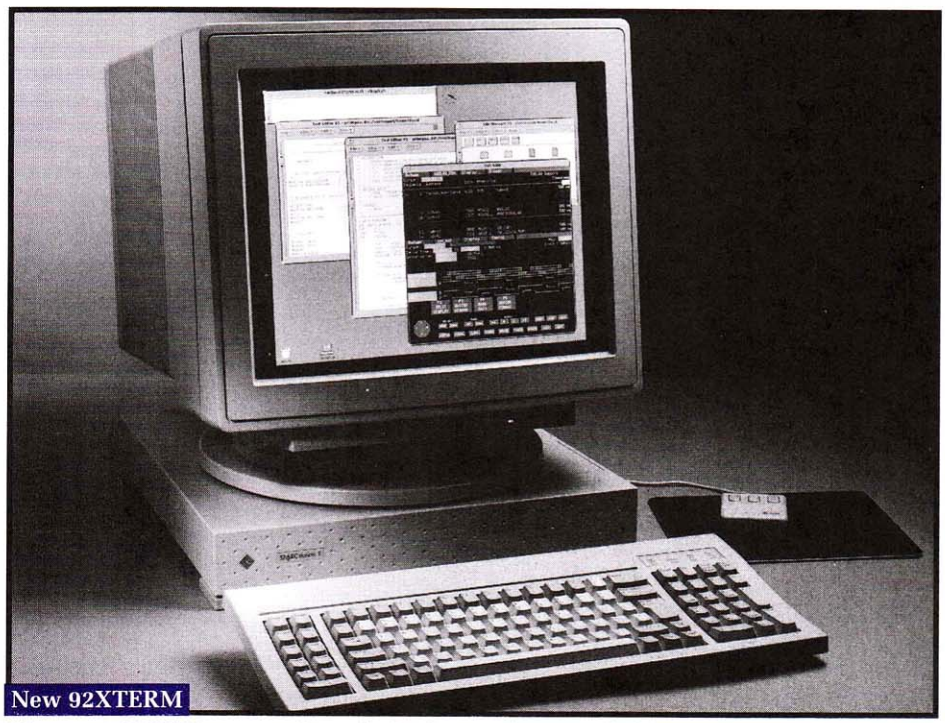
Since most logic analyzers can't handle hundreds of timing channels, they don't worry about displaying more than a few channels at a time. With the DAS9200 bus waveform display, multiple 32-bit buses can easily fit on the same timing diagram, even the buses are cross-correlated to other displays.



The removable hard disk option provides an added measure of security.

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

Digital Analysis System



The new 92XTERM support allows the DAS9200 to be controlled from any SPARC-based Sun workstation.

A WIDE RANGE OF ACQUISITION CARDS

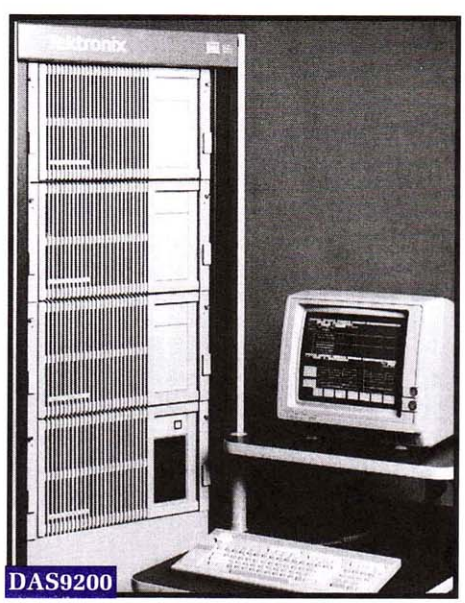
For state analysis or microprocessor support, the solutions are the 92A60, 92A90, and 92A96 acquisition cards. The 92A60/90 handles 40 MHz clock rates and 20 MHz bus rates. The 92A60 available in 32K memory depth, and the 92A90 is available in 32K and 128K memory depths. The 92A60 is 60 channels wide and the 92A90 is 90 channels wide. The 92A96 handles clock and bus rates up to 100 MHz without performance compromises and is available with memory depths of either 8K, 32K, 128K, or 512K. The 92A96 is 96 channels wide and can be extended to 384 channels.

For high speed timing, there are the 92A16 and the 92HS8. The 92A16 offers 200 MHz clock and bus rate acquisition with 4K memory depth. The 92A16 is 16 channels and can be expanded to 96. The 92HS8 is eight-channels wide and can sample at 2 GHz (500 ps) across as many as 160 channels.

The extremely sophisticated triggering of these instrument modules offer unmatched power and flexibility. To simplify triggering, editable pre-programmed libraries of triggering set-ups are included. The libraries are easily modified and expanded to allow full utilization of the powerful triggering capabilities.

MAINFRAMES THAT OFFER CHOICES

The high performance DAS/SE is controlled by a 40 MHz, 32-bit CPU and contains 16 MB of system RAM, a 100 MB Hard Disk, and a PC compatible 1.2 MB Floppy Drive. A removable hard disk is also available. The communications ports on the DAS/SE include three RS-232 I/O ports and seven instrument card slots, and optional interfaces for Ethernet LAN and industry-standard GPIB.



Up to three expansion mainframes can expand the system to 28 card slots.

The 9201T 14-inch color terminal can be used for stand-alone operation of the DAS/SE.

The new 92XTERM package displays an enhanced DAS9200 user interface in an X-window on a Sun SPARC workstation. It permits remote access to the DAS user interface over a network. The user accesses the DAS9200 from his desk while the DAS is still in the lab.

The DAS/SE can also be controlled in a lab environment by using PCL, a complete, high-level remote control language. PCL can be used to remotely control a DAS/SE from another computer or controller, over RS-232, GPIB, or Ethernet LAN.

Acquired data is easily documented for future reference. Full color printouts of any screen are available by attaching a Tektronix color copier to the parallel printer port on the 9201T. Acquired data and module setups can be printed to the DAS/SE serial printer port in ASCII, Epson FX, Epson LQ, IBM Proprinter, and Postscript formats.

The DAS92E9 expansion chassis is used to expand the number of instrument card slots, and must be used with a DAS9200 mainframe. The expansion chassis includes an expansion receiver card and cabling, and offers eight additional instrument card slots. A system maximum of 28 card slots are available in a fully expanded system consisting of one DAS9200 mainframe and three DAS92E9 expansion chassis.

SYMBOLIC PERFORMANCE ANALYSIS

With increasingly complex software, speed and size become harder to manage. When software begins to bog down, you need to know where it's spending all its time. With 92PA Real Time Performance Analysis, you can chart the ranges where software is running. The screen updates rapidly and data can be sorted while running.

Data can be sorted into 5000 ranges, so everything can be measured in one pass. Data for the ranges can be imported directly from other applications, easing the definition of ranges. The output of the 92PA can be saved as an ASCII file for later analysis.

PATTERN GENERATION AT UP TO 100 MHZ

For stimulus requirements you can choose between the 92S16/S32 and the 92SX109/SX118. These sub-systems offer data rates of up to 50 MHz and 100 MHz respectively. Patterns can be output either sequentially or algorithmically using a command structure that includes subroutine calls. These pattern generators can be combined with any of the acquisition cards to provide powerful stimulus/response systems.

LONG TERM PRODUCT SUPPORT

Every DAS9200 mainframe and instrument card is delivered to you with a full one year on-site service warranty. (This support may not be available in all geographic areas. Check with your local Tektronix sales engineer.) The warranty period can be extended to two or three years at the time you purchase your system. A toll-free, telephone "Hot Line" (U.S. only) is also accessible as part of the Software Subscription Service offered for the DAS9200.

DAS9200 92A96SD MODULE

Digital Analysis System

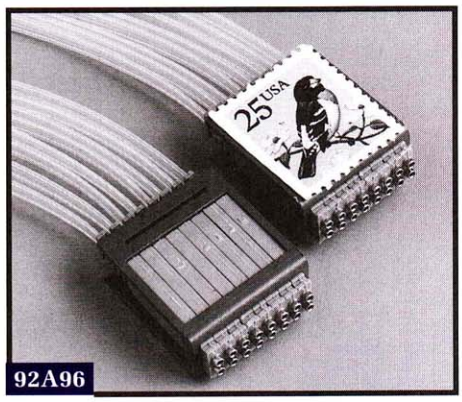
100 MHz Acquisition

The Hottest State and Timing Acquisition... New 512K deep Acquisition Card.

92A96SD MODULE

- 96-384 Channels @ 100 MHz Sync or Async
- 100 MHz Clocking State Machine Tracks Fast, Complex Buses
- 100 MHz, 16 State Triggering State Machine
- 100 MHz Timestamp
- Available in 8K, 32K, 128K, or 512K Memory Depths
- Time-Correlated to Other State/Timing Modules
- Bus-Form Timing Display
- Compact, High Bandwidth Probes
- Provides Timing Analysis Through Same Probes

The new 92A96SD offers an unprecedented memory depth of 512K bits per channel.



The 92A96 provides accessibility to signals with 8-channel probes as small as a US postage stamp.

State Analysis or Microprocessor Support

For high speed state analysis or microprocessor support, the solution is the 92A96 Centurion acquisition card. The 92A96 Centurion handles clock and bus rates up to 100 MHz without compromising any performance features and is available with memory depths of 8K, 32K, 128K, or 512K. The 92A96 Centurion is 96 channels wide and can be extended to 384 channels.

TIMING AND HIGH SPEED STATE ANALYSIS

In timing mode, 92A96 modules can be expanded to a system total of 1536 channels, with 100 MHz sampling on all channels. These cards can also sample at up to 400 MHz on a reduced number of channels. There are no speed or memory compromises when you add time stamping or go to disassembly.

WHY HIGH BANDWIDTH PROBES?

Probes are the highest volume component in a logic analyzer and represent a large fraction of the total cost. Probes for the 92A96 use precision NiCr coax and hybrids embedded in the podlets. The specifications are at the probe tip, not at the connector on the acquisition card. Tektronix probes will not add to the uncertainty in your system under test. The 92A96 has analog bandwidth greater than 150 MHz and can easily handle 100 MHz synchronous acquisition with a setup and hold window of 5 ns of less.

CONNECT PROBES ONCE!

Probes for logic analyzers are usually optimized for large channel counts at the expense of performance, which makes it difficult to perform timing analysis on the large number of channels necessary for state analysis. The compact 8-channel probes of the 92A96 allow convenient connection to wide buses without compromising timing performance. You can connect to a microprocessor bus for state analysis with disassembly and change to fast asynchronous bus timing without switching probes!

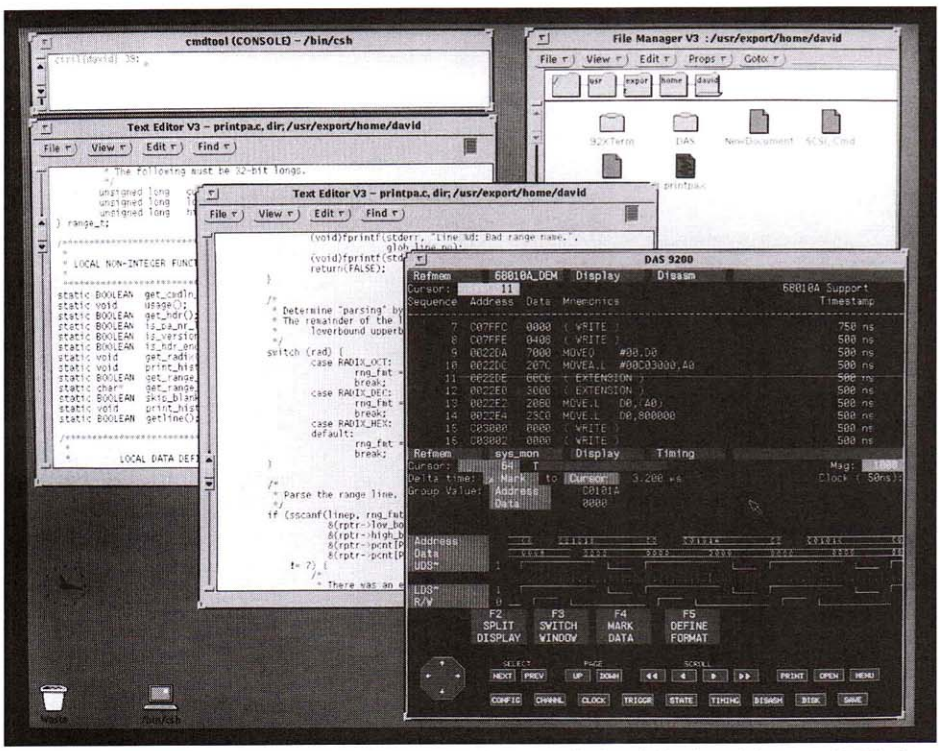
WHY DEEP MEMORY?

In most situations, triggering starts on a visible symptom of a problem. With microprocessor-based designs, the cause of a problem is often separated from the symptom by a long time and a lot of bus activity. To trace down the cause of the symptom, you need to go backwards in acquisition memory to the time of the cause. Only a deep trace buffer with full trigger positioning can prepare you for this kind of problem.

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

Digital Analysis System
Hosted DAS

DAS9200
92XTERM
92LANSE



The new 92XTERM support allows the DAS/SE to be controlled and displayed from an X-Window.

Control the DAS from a SPARCstation X-Window

The 92XTERM provides you with a means of accessing your DAS/SE in an X-window on a Sun SPARC workstation. Your DAS/SE can remain in the lab while you work in your office, on your workstation, where all your development tools are located. A DAS/SE can also be sequentially shared by multiple users.

The 92XTERM provides you with an enhanced DAS9200 user interface, similar to the one on a 9201T terminal. The enhancements to the user interface include faster screen updates, full control from on-screen function keys, a mouse interface for pointing and selecting menu items, and the flexibility of an X-window.

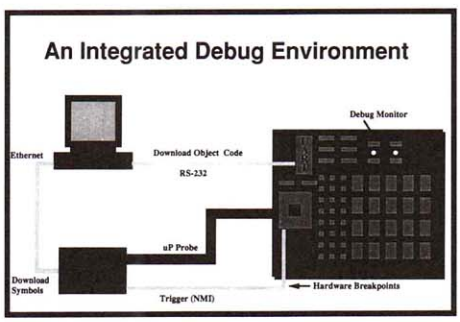
The 92XTERM requires a Sun SPARC-based workstation, a DAS/SE, and a LAN interface.

IMPROVED THROUGHPUT WITH THE NEW 92LANSE CARD

The new 92LANSE card provides a faster network connection to the DAS/SE, up to four times the rate of the current 92LAN at a greatly reduced price. The software interface has been completely redesigned, increasing the number of available sockets. The need for expansion has also been addressed to allow future network enhancements.

INTEGRATE THE DAS/SE WITH HIGH LEVEL SOFTWARE TOOLS

With the LALINK software tools, you can link the DAS/SE to your high level debug tools. Real time trace and hardware breakpoints can be added to your debugger by integrating it with the DAS/SE. Cross compilers, debug monitors, and source level debuggers are all available through LALINK. The new network tools allow simple data transfer for symbol tables, results, etc.



LA CONNECT combines a logic analyzer, a debug monitor, and a source level debugger to provide a real-time debug environment for today's fastest and most complex microprocessors.

92XTERM/92LANSE

- Full Control and Display Capability on a Workstation
- X-Windows Support Allows Multiple Applications to be Displayed Simultaneously
- High Performance Ethernet LAN Interface for Fast Data Transfer

The NEW 92XTERM for Increased Productivity.

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

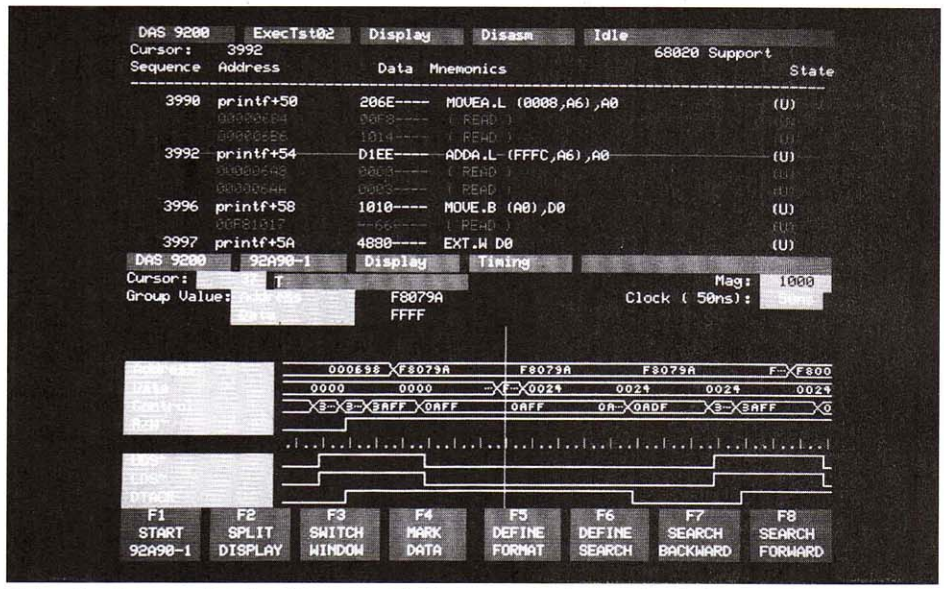
Digital Analysis System

Microprocessor Support

Ease Microprocessor Debug with DAS9200.

DAS9200

- Support for many Popular RISC/CISC Microprocessors
- Multiprocessor Support for up to 8 CPUs at Once
- State or Timing Displays with the Same Probes



Using the time correlated, split-screen display, you can observe detailed system interactions in any format you choose.

Configured Support Packages Ease Microprocessor Debug

Debugging a system with several microprocessors would require the attachment of hundreds of probes. After you attach those probes, and you acquire megabytes worth of data, how do you analyze it all? The DAS9200 provides you with a variety of display format options. You can start with a macroscopic view of subroutine entry and exit points. Then, without reacquiring, gradually zoom in on specific activities and values. You can view control flow, assembly instructions, and cycle-by-cycle bus activity.

Tektronix microprocessor support doesn't limit you to simple inverse disassembly. Instead of merely translating data on a line-by-line basis, the 92A96 and has a sixteen state clocking state machine that emulates the behavior of a complex microprocessor bus, actually predicting branches and cache flushes, and automatically re-synchronizing disassembly.

EDITABLE AND DOWNLOADABLE SYMBOL TABLES

The DAS9200 has a Symbol Editor which can enter or modify symbols, or enter a base offset for relocatable code, or even download symbols from another computer. It supports multiple files with thousands of symbols per file. LA-LINK software will extract symbol information from the output of various compilers and convert it to Tektronix symbol format. This allows the linking of a high level language trace display to the data acquired by the logic analyzer.

DATA IS FORMATTED FOR CLEAR ANALYSIS

Hardware display format helps you track problems specific to hardware/software interaction by showing you every bus transaction in order of occurrence. Software display format shows you what would be found in an assembly listing, with data transfers optionally included. Control flow mode displays only the instructions that cause program branching. And in subroutine trace mode, you see only subroutine calls and returns, obtaining a high-level overview of program execution.

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

Digital Analysis System
Microprocessor Support

INTEGRATION IS PREVALENT IN TODAY'S DESIGNS

Hardware is linked to microprocessors, software to hardware, and multiple processors to one another. Dozens of engineers may be working together on a project. Multiple components, multiple designs, and multiple levels of complexity mean problems built-in from the very beginning.

What's more, these problems usually are not discovered until the integration stage, when the interactions of many designs are tested and debugged. At this point, they're difficult to correct, and they have a critical impact on your project schedule.

A time-correlated, split-screen display lets you scroll through disassembly of timestamped data acquired from any two processors, and quickly understand what each is doing at a single point in time. You can lock the cursors in separate display windows so both screens scroll together in accurate time alignment.

Real-time event handshaking between the different instrument cards lets you identify data across multiple acquisition modules and trigger them simultaneously to acquire the data necessary for time alignment. And pattern generation lets you simulate interactions of hardware that's not properly working.

Perhaps best of all, you can debug hardware and software components and system interactions using the same card modules, reconfiguring them from the keyboard without physically moving them.

MICROPROCESSOR SUPPORT ORDERING INFORMATION

DAS9200 MICROPROCESSOR SUPPORT

92DM03 – 8086 Support **$1,250**
Opt. 1D – Delete Probe Adapter (Software only) ..... **–$500**

92DM04 – 8088 Support **$1,250**
Opt. 1D – Delete Probe Adapter (Software only) ..... **–$500**

92DM05 – 80186 Support **$1,250**
Opt. 1D – Delete Probe Adapter (Software only) ..... **–$500**

92DM06 – 80188 Support **$1,250**
Opt. 1D – Delete Probe Adapter (Software only) ..... **–$500**

92DM08 – 80286 Support **$1,600**
Opt. 1D – Delete Probe Adapter (Software only) ..... **–$700**

92DM09A – 80386DX Support **$2,500**
Opt. 1D – Delete Probe Adapter (Software only) ..... **–$700**
Opt. 04 – (1) 90-CH Interface ..... **+$950**
Required for use with 92A96 modules.

92DM10 – 80386SX Support **$2,500**
Opt. 1D – Delete Probe Adapter (Software only) ..... **–$950**
Opt. 1S – Sub. adapter for soldered 100–pin PQFP ..... **NC**
Opt. 3S – Sub. adapter for AMP 100–pin PQFP ..... **+$225**
Opt. 04 – (1) 90-CH Interface ..... **+$950**
Required for use with 92A96 modules.

92DM12 – 80486 Support **$4,950**
Opt. 1D – Delete Probe Adapter (Software only) ..... **–$750**
Opt. 2S – Sub. low profile probe adapter ..... **NC**

92DM15 – i860 Support **$4,950**
Opt. 1D – Delete Probe Adapter (Software only) ..... **–$1,950**
Opt. 04 – (2) 90-CH Interfaces **$1,900**
Required for use with 92A96 modules.
The 92DM15 requires two acquisition modules.

92DM17 – 80960 Support **$4,950**
Opt. 1D – Delete Probe Adapter (Software only) ..... **–$750**
Opt. 2S – Sub. low profile probe adapter ..... **NC**

92DM24 – 6809/6809E Support **$900**
Opt. 1D – Delete Probe Adapter (Software only) ..... **–$400**

92DM27 – 68000/68010 Support **$1,250**
Opt. 1D – Delete Probe Adapter (Software only) ..... **–$500**
Opt. 2S – Sub. PGA adapter ..... **NC**

92DM31A – 68020 Support **$2,500**
Opt. 1D – Delete Probe Adapter (Software only) ..... **–$700**
Opt. 04 – (1) 90-CH Interface ..... **+$950**
Required for use with 92A96 modules.

92DM33A – 68030 Support **$2,500**
Opt. 1D – Delete Probe Adapter (Software only) ..... **–$700**
Opt. 04 – (1) 90-CH Interface ..... **+$950**
Required for use with 92A96 modules.

92DM34 – 68040 Support **$4,950**
Opt. 1D – Delete Probe Adapter (Software only) ..... **–$750**
Opt. 2S – Sub. low profile probe adapter ..... **NC**

92DM35A – 88100 Support **$4,950**
Opt. 1D – Delete Probe Adapter (Software only) ..... **–$1,950**
Opt. 04 – (2) 90-CH Interface ..... **+$1,900**
Required for use with 92A96 modules.
The 92DM35A requires two acquisition modules.

92DM41 – Z80 Support **$900**
Opt. 1D – Delete Probe Adapter ..... **–$400**

92DM64 – 1750A Support **$1,000**
Opt. 1D – Delete Probe Adapter ..... **–$400**
Opt. 10 – Flying lead PIA w/Grabber clips ..... **+$750**
Opt. 11 – Flying lead PIA, Stripped/Tinned leads ..... **+$650**
Opt. 12 – DIN to DIN Cable PIA ..... **+$750**
Opt. 13 – F9450 Flex Cable PIA w/o Extended memory ..... **+$1,600**
Opt. 14 – F9450 Flex Cable PIA w/Extended memory ..... **+$2,100**

92DM72A – AMD 29000/050 Support **$4,950**
Opt. 1D – Delete Probe Adapter ..... **–$750**

92DM74 – MIPS R3000/A Support **$4,950**
Opt. 1D – Delete Probe Adapter ..... **–$950**
Opt. 2S – Sub. low profile probe adapter ..... **NC**

92DM77A – SPARC CY7C601/L64811/MB86903 Support **$4,950**
Opt. 1D – Delete Probe Adapter ..... **–$950**
Compatible with 92A96 modules only.

92DM901 – MCS-51 Family Support **$800**
Opt. 1D – Delete Probe Adapter ..... **–$550**

92DM902 – 8085 Support (DIP) **$450**
Opt. 1D – Delete Probe Adapter ..... **–$200**

92DM909 – VME Bus support **$750**
Includes: 6U bus interface, application software, and documentation. Compatible with 92A60/92A90 modules only.

92DM912 – 68000/10 Support **$1,200**
Opt. 1D – Delete Probe Adapter ..... **–$650**
Opt. 2S – Sub. PGA Probe Adapter ..... **NC**

92DM913 – Z80 Support **$800**
Opt. 1D – Delete Probe Adapter ..... **–$550**
Compatible with 92A96 modules only.

92DM914 – 96002 Support (PGA/ET) **$1,500**
Opt. 1D – Delete Probe Adapter ..... **–$750**

92DM916 – 80960KA/KB/MC Support (PGA/LASI III) **$1,500**
Opt. 1D – Delete Probe Adapter ..... **–$750**

92DM920 – TMS320C3X Support (PGA 181) **$1,500**
Opt. 1D – Delete Probe Adapter ..... **–$750**
Opt. 2S – Sub. PGA Probe Adapter ..... **NC**
Compatible with 92A96 modules only.

Note: Option 88, Factory Installation and Test, is a no charge option available for all DAS9200 instrument cards ordered with a new mainframe. This option assures that the card is installed in the mainframe and tested at the factory. The two components are then shipped together.

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

Digital Analysis System

Instrument Modules and Extended Support

Instrument Modules and Extended Support.

- One Year Warranty
- Extended Support
- On-site Installation Available

Instrument Module Selection Guide

The following instrument cards include probes. A maximum of seven instrument cards may be installed in a DAS9221, depending on the cards. A maximum of eight instrument cards may be installed in a DAS92E9, depending on the cards. Each mainframe includes sufficient power for all card slots. Additional options are available, please consult your local Sales Engineer.

MODULE TYPE	Description	Resolution Internal Clock	Resolution External Clock	Maximum per Card	Channels per System	Memory Depth (per Ch.)	Price
Acquisition							
92A16	Master	5 ns	5 ns	16	384	4K	**$9,750**
92A16E	Expander	5 ns	5 ns	16	NA	4K	**$9,550**
92A60	Master or Expander	50 ns	50 ns	60	360	32K	**$9,990**
92A90	Master or Expander	50 ns	50 ns	90	540	32K	**$12,700**
92A90D	Master or Expander	50 ns	50 ns	90	540	128K	**$16,900**
92A96	Master or Expander	2.5 ns	10 ns	96	1,536	8K	**$14,950**
92A96D	Master or Expander	2.5 ns	10 ns	96	1,536	32K	**$17,950**
92A96XD	Master or Expander	2.5 ns	10 ns	96	1,536	128K	**$20,950**
92A96SD	Master or Expander	2.5 ns	10 ns	96	1,536	512K	**$25,950**
92HS8	Master	500 ps	1.43 ns	8	160	8K	**$25,980**
92HS8E	Expander	500 ps		8	NA	8K	**$25,980**
Pattern Generator							
92S16	Algorithmic	20 ns	20 ns	18	936	1K	**$7,290**
92S32	Sequential or Expander	20 ns	20 ns	36	1008	8K	**$9,430**
92SX109	Algorithmic	10 ns	10 ns	9	468	2K	**$9,600**
92SX118	Sequential or Expander	10 ns	10 ns	18	504	16K	**$12,500**

Warranty, Installation, and Extended Support

All DAS9200 products and pre-configured systems are covered by a 1 year comprehensive, on-site warranty. This warranty provides you with a priority response if ever your system needs service. There are no materials, time, travel, or expense costs to deal with. Plus, you have toll-free access to the National Support Center (NSC). The NSC is staffed from 6:00 am to 6:00 pm PST. Questions regarding the systems capabilities or operation can now be easily answered in just one free phone call.

You have the option to extend this support at the time you purchase your system for a total coverage period of two or three years.

On-site installation is also available as an option to your system. When you purchase on-site installation, the service technician will:

- Set-up and configure your system.
- Configure and integrate all optional accessories.
- Run diagnostics to completely verify functionality.

To gain the benefit of these services, specify the following options with your order:

Option Q0 – On-Site Installation

Option W2 – 2 Yr HW/SW Support & NSC Hotline Access

Option W3 – 3 Yr HW/SW Support & NSC Hotline Access

ORDERING INFORMATION

STANDARD CONFIGURATIONS

The most popular standard configuration includes the DAS9221 mainframe, a 9201T terminal, and one to four 92A96D acquisition modules. For other configurations, please see your local sales specialist or for full ordering information see configuration guide. (Order 57A-8296-0).

DAS9281
96-Ch High-Performance Processor Support **$29,950**
Includes: 1 92A96D with a DAS9221 mainframe.

DAS9282
96-Ch High-Performance Processor Support **$46,860**
Includes: 2 92A96Ds with a DAS9221 mainframe.

DAS9283
96-Ch High-Performance Processor Support **$63,770**
Includes: 3 92A96Ds with a DAS9221 mainframe.

DAS9284
96-Ch High-Performance Processor Support **$80,680**
Includes: 4 92A96Ds with a DAS9221 mainframe.

OPTIONS COMMON TO STANDARD CONFIGURATIONS

Opt. 1S – Substitutes all 92A96Ds w/ 128K 92A96XDs
DAS9281 ..... **+$3,000**
DAS9282 ..... **+$6,000**
DAS9283 ..... **+$9,000**
DAS9284 ..... **+$12,000**

Opt. 2S – Substitutes all 92A96Ds w/ 512K 92A96SDs
DAS9281 ..... **+$8,000**
DAS9282 ..... **+$16,000**
DAS9283 ..... **+$24,000**
DAS9284 ..... **+$32,000**

Opt. 1X – Adds Sun X-Window Support ..... **+$2,000**
Subs. 92LANSE and 92XTERM for 9201T terminal.

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

Digital Analysis System
Ordering Information

ORDERING INFORMATION

DAS9200 MAINFRAMES

DAS9221
Basic Mainframe **$14,750**
Includes: 40 MHz CPU, 16 MB RAM, 100 MB Hard Disk, and 1.2 MB Floppy Drive.

DAS9229
Basic System **$16,500**
Includes: DAS9221 Mainframe and 9201T Display.

DAS92E9
8 Card Slot Expansion Mainframe **$6,850**
Opt. 3C – Expansion Only Interface (92C03) ..... **+$1,500**

92F221
Upgrades DAS9219/9220 Mainframe to DAS9221 (DAS/SE) **$6,500**
Includes: CPU card, DAS/OS, and 100MB HDD.

92F221X
Upgrades DAS9219/9220 Mainframe to XTERM compatible DAS9221 (DAS/SE) **$9,950**
Includes: 92F221, 92LANSE, 92XTERM, and on-site installation (U.S. only).

OPTIONS COMMON TO ALL DAS MAINFRAMES
Opt. 1A – 115V/15A Power Cord ..... **N/C**
Opt. 1B – 125/208V 3-Phase Power Supply ..... **+$180**
Opt. 05 – Rackmount Kit ..... **+$400**
Opt. 2C – GPIB/Expansion Interface (92C02) ..... **+$1,950**
Opt. 18 – Sub. Removable HD for Std. HD ..... **+$350**
Opt. 4C – Adds 92LANSE LAN module ..... **+$950**

WARRANTY-PLUS SERVICE PLANS OPTIONS
Opt. Q0 – Installation Service *1
Opt. W2 – Customer Site HW/SW Service *1

SOFTWARE

92PA
DAS/SE Performance Analysis Software **$950**

COMMUNICATION INTERFACES

92C02
GPIB/Mainframe Expansion Interface **$1,950**

92LAN/SE
Ethernet LAN Interface **$950**

92LANP
LAN Programmatic Control Language Software **$950**
Includes: DAS9220 Application S/W, C Source Code for Host Computer, and Documentation.

DAS9200 TRAINING SYSTEMS

92WBOOK
DAS9200 Workbook/Tutorial, Software and Training Aid **$95**

92WBMP
DAS9200 Microprocessor Support Workbook **$95**

92WBPCL
DAS9200 Programmatic Control Language (PCL) Workbook **$95**

DAS9200 ACQUISITION CARDS

92A16
16-CH, 200MHz Sync/Async, Master Acquisition Card, 4K deep **$9,750**
Includes: (2) P6461 probes and leadsets.
Opt. 2S – Sub. 2-P6460 probes for 2-P6461 ..... **–$1,700**

92A16E
16-CH, 200MHz Sync/Async, Expansion Acquisition Card, 4K deep **$9,550**
Includes: (2) P6461E probes and leadsets.
Opt. 2S – Sub. 2-P6460 probes for 2-P6461 ..... **–$1,300**

92HS8
8-CH, 2GHz Async/350MHz Ext. Async, Master Acquisition Unit, 8K deep **$25,980**
Includes: Probes, leadsets, and MF Interface.
Opt. 05 – Rackmount Kit ..... **+$300**

92A60
60-CH, 20MHz Sync/Async, Master/Slave Acquisition Card, 32K deep **$9,990**
Includes: Probe and general purpose leadset.

92A90
90-CH, 20MHz Sync/Async, Master/Slave Acq. Card, 32K deep **$12,700**
Includes: Probe and general purpose leadset.
92A90D – 128K deep **$16,900**

92A96
96-CH, 100MHz Sync/400 MHz Async, Master/Slave Acq. Card.
Includes: probes and leadsets
92A96 – 8K deep **$14,950**
92A96D – 32K deep card **$17,950**
92A96XD – 128K deep card **$20,950**
92A96SD – 512K deep card **$25,950**
Opt. 01 – 90-CH Microprocessor Interface ..... **+$950**
Opt. 02 – Coax Ribbon Cables ..... **+$2,950**

DAS9200 PATTERN GENERATOR CARDS

92S16
18-CH, 50MHz Algorithmic Pat. Gen., 1K deep. **$7,290**
Includes: 2-P6464 probe and leads.
Opt. 2S – Sub. 2-P6465 probes for 2-P6464 probes ..... **+$600**

92S32
36-CH, 50MHz Sequential Pat. Gen., 8K deep. **$9,430**
Includes: 4-P6464 probes and leads.
Opt. 1S – Sub. 1-P6465 probe for 1-P6464 probe ..... **+$300**
Opt. 2S – Sub. 2-P6465 probes for P6464 probes ..... **+$1,200**
Opt. 3S – Sub 4-P6463 probes for 4-P6464 probes ..... **–$1,600**
Opt. 4S – Sub. 2-P6463 probes for 2-P6464 probes ..... **–$3,600**

92SX109
9-CH, 100MHz Algorithmic Pat. Gen., 2K deep. **$9,600**
Includes: 1–Pat. Gen. Multiplexer, and 1-P6464 probe and leads
Opt. 09 – Add (1) P6464 Output Data Probe ..... **+$1,400**
Opt. 11 – Add 1-P6460 External Control Probe ..... **+$750**

92SX118
18-CH, 100MHz Sequential Pat. Gen., 16K deep **$12,500**
Includes: 2-Pat. Gen Multiplexers, and 2-P6464 probe and leads.
Opt. 09 – Add (2) P6464 Output Data Probe ..... **+$2,800**

**1 Contact your local Tektronix representative for price information.*

Note: Option 88, Factory Installation and Test, is a no charge option available for all DAS9200 instrument cards ordered with a new mainframe.

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

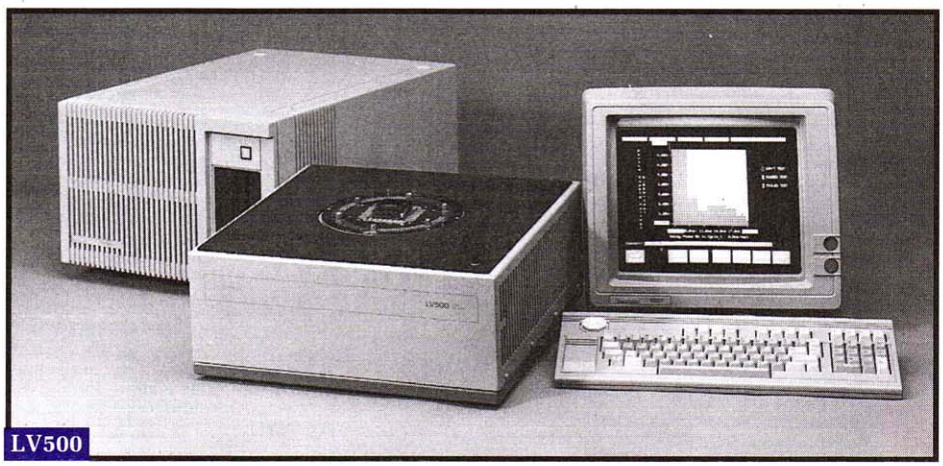
LV500

Verification System

The designers solution.

LV500

- Per-Cycle Definition of Timing
- Compact Benchtop System
- 50 MHz Test Rates
- 64 TO 256 I/O Channels
- 64K Pattern Depth
- Up to 16 Clocks (32 Programmable Edges)
- 1, 2, or 3 Year Warranty Available



LV500

Versatile Clocking

The LV500 is the first Verification System able to match the timing flexibility found in logic simulators and large production testers. Its sophisticated timing allows much more of the simulation information to be transferred to the test program. Until now verification systems have been equipped with fixed vector timing, limiting their ability to reproduce simulation vectors and making it difficult to compare simulation and prototype test results. Using the LV500, you can reproduce your Efficient Human Interface.

The human interface of the LV500 allows designers to work in a familiar environment. Timing is defined in the same format as that found in IC data books, and parameters are adjustable using pop-up menus.

The configuration screen allows quick setting of power supplies, force voltages, and compare voltages. The DUT wiring screen maps data signals to the tester channels. The mapping of channels may be set up automatically, defined inter-actively, or extracted from a previous setup.

Powerful Test Vector Creation

You can easily use simulation data to create test vectors for the LV500. The system can accept data from virtually any logic simulator. It has turnkey solutions for Mentor's QuickSim, Daisy's DLS, Hilo, Valid, and Laser. During the translation process, timing and functional information is extracted from the simulation data to automatically set up the Template screens (defining test cycle timing), the Pattern screen (defining test vectors), the Channel Grouping screen, and the DUT Wiring screen with little or no input.

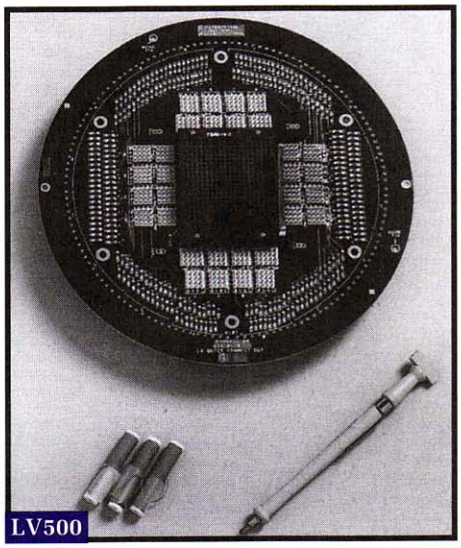
Sometimes you may want to create or edit test patterns manually. The pattern editor is simple yet powerful, with the ability to create high level pattern macros. This makes it easy for you to generate and document test patterns for your devices.

The LV500 series has been enhanced with a 40 MHz 32-bit CPU, 16 MB RAM, 100 MB HD, and 1.2 MB PC compatible floppy drive to provide even quicker turn-around times when testing ASICs.

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99

GPIB IEEE-488 — The LV500 complies with IEEE Standard 488.1-1987, and with Tektronix Standard Codes and Formats.

Verification System



The LV500 Quick Connect DUT Card Kit.

ORDERING INFORMATION

LV511
64 CH ASIC Verification System **$55,000**

LV512
64 CH ASIC Verification System **$94,000**

LV513
192 CH ASIC Verification System **$133,000**

LV514
256 CH ASIC Verification System **$172,000**

The following options are available for all LV 500 Systems:

INTERNATIONAL POWER PLUG OPTIONS

Opt. A1 – Universal Euro: 220 V, 50 Hz ..... **NC**
Opt. A2 – United Kingdom: 240 V, 50 Hz ..... **NC**
Opt. A3 – Australian: 240 V, 50 Hz ..... **NC**
Opt. A4 – North American: 240 V, 60 Hz ..... **NC**
Opt. A5 – Switzerland: 220 V, 50 Hz ..... **NC**

See General Customer Information Section for additional description.

WARRANTY-PLUS SERVICE OPTIONS

Opt. Q0 – Installation Service
LV511 ..... **+$600**
LV512 ..... **+$700**
LV513 ..... **+$800**
LV514 ..... **+$900**

Opt. W2 – Customer Site HW/SW Service
LV511 ..... **+$4,433**
LV512 ..... **+$6,340**
LV513 ..... **+$8,680**
LV514 ..... **+$11,020**

DUT CARDS

Opt. 2C – GPIB/Expansion Interface
(standard on the LV 514) ..... **+$1,950**
Opt. 4C – EtherNet LAN Interface ..... **+$3,600**
Opt. 3M – Simulator Translator S/W ..... **+$1,000**
Opt. 18 – 80 MB Removable Hard Disk ..... **+$350**

Pin Grid Array DUT Card –
(Pkg of five). Order 020-1740-00 ..... **$1,060**
(Pkg of ten). Order 020-1741-00 ..... **$1,895**
For 0.1 center-to-center device sockets. 256 channels routed to a connection area surrounding a 21 by 21 matrix of holes for mounting the device socket.

Dual Inline package DUT card –
(Pkg of five). Order 020-1738-00 ..... **$1,015**
(Pkg of ten). Order 020-1739-00 ..... **$1,895**
For DIP packages with up to 64 signal pins. Pins are prewired to LV 500 channels. For DIP sockets with 0.3, 0.4, 0.6, or 0.9 inch centers. All signals can be series-terminated.

Scratch Pad DUT Card –
(Pkg of five). Order 020-1809-00 ..... **$1,060**
(Pkg of ten). Order 020-1810-00 ..... **$1,895**
0.1 grid (center-to-center) for developments of custom device interfaces. Grid area is 5.5 inches in diameter.

Quick Connect PGA DUT Card Kit – For quick interface to up to 19 by 19 PGA devices. Wire device pins to tester channels via insulation displacement terminal strips. Includes ZIF socket, termination resistors, wiring strips, wire insertion tool, and wire.
Order 020-1777-00 ..... **$1,025**

Coaxial Cable DUT Card – For interface to probes, chip handlers, and custom test fixtures. Includes DUT card, 75 Ω/60 cm coaxial cables, cable clamp, and power supply ribbon cable. Coax cables connect to standard 0.1 inch center square pins.

DUT card and 64 coax cables – Order 020-1801-00 ..... **$3,900**
DUT card and 128 coax cables – Order 020-1802-00 ..... **$4,900**
DUT card and 192 coax cables – Order 020-1898-00 ..... **$5,900**
DUT Card and 256 coax cables – Order 020-1803-00 ..... **$6,900**
DUT Card only – Order 020-1804-00 ..... **$2,900**
Static Grounding Wrist Strap – Order 006-7248-00 ..... **$19.25**

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

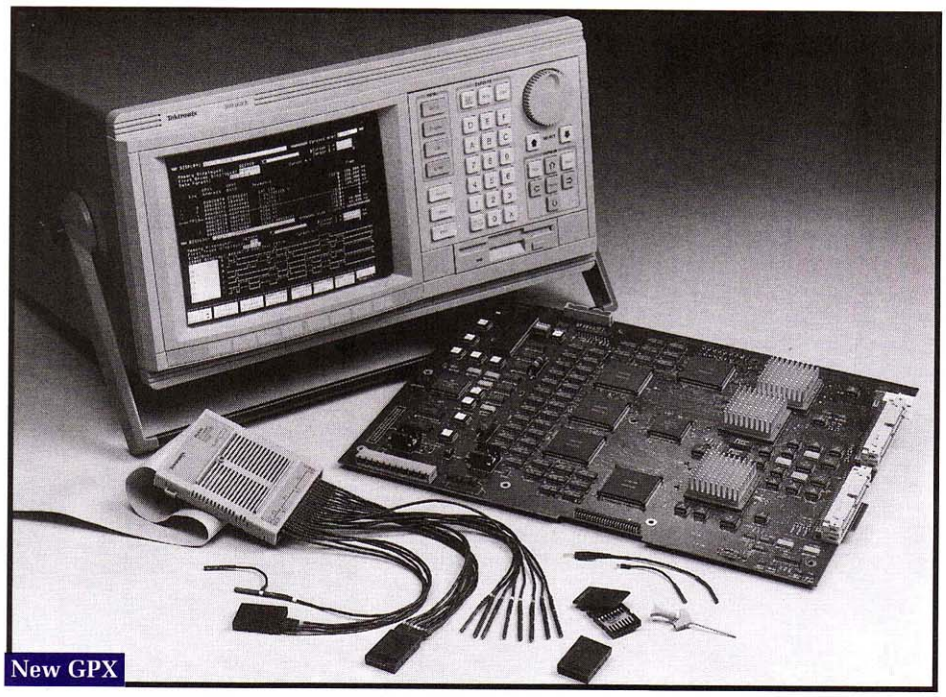
GPX Logic Analyzers

Eight Tools in One Low Cost Instrument. The New GPX logic analyzer provides a complete set of features for the whole design team.

Multiple tools are available in 3 mainframes to customize your system to your exact needs.

GPX LOGIC ANALYZER

- 1 GHz High Speed Timing Analysis - 16/32 Channels
- 200 MHz Timing Analysis - 80/160 Channels
- 80 MHz State Analysis - 80/160 Channels
- Simultaneous State And Timing - No Double Probing
- Comprehensive Microprocessor Support
- Real-Time Performance Analysis
- ROM Emulation
- Links to High Level Languages for Software Debug
- Innovative & Compact 100 mil sq. Probing System
- Double your Channels by Welding Two Modules Together.
- General Purpose and Microprocessor Analysis Module (32GPX)
- 2 GHz High Speed Timing Analysis Module (30HSM)
- 400 MS/s Digitizing Oscilloscope (30DSM)
- Lower Cost Microprocessor Analysis Module (30MPX)
- 3001 Portable Mainframe
- 3002C Color Modular Mainframe
- 3002P Portable Modular Mainframe


New GPX

New GPX Logic Analyzer

The New GPX Logic Analyzer is an outstanding value in general purpose logic analysis. The monolithic 3001GPX is designed for medium size applications or where portability is important. The modular 3002 based GPX systems can house up to four modules in a single system and is suited for larger, more complex applications.

8 TOOLS IN ONE INSTRUMENT

The GPX logic analyzer was designed to offer capability that everyone on the design team needs. The GPX provides specific features for:

- Hardware Debug
- Software Debug
- HW/SW Integration
- Evaluation
- System Test
- System Optimization

If your budgets are tight and you can only afford one instrument, the GPX is the one to choose.

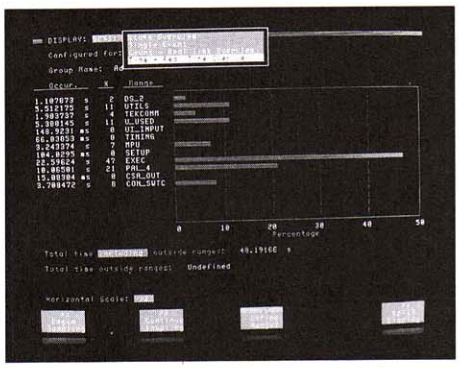
3000 SERIES APPLICATION MODULE SELECTION GUIDE

Product	Application	Channels/Card	Rate	Clock Type	Memory	Triggering
32GPX (page 168)	General Purpose Microprocessor Hardware/ Software Integration	80-160*1 80-160*1 16-32*1	80 MHz 200 MHz 1 GHz	Synchronous Transitional Conventional	4K 8K 40K	4 States/16 levels 4 Word/ Range recognizers 2 Counter/Timers
30MPX (page 170)	8/16/32-bit - Microprocessor Hardware / Software Integration	96 9	16 MHz*2 200 MHz or 90 MHz	Synchronous Transitional Synchronous	8K 2K 2K	7 States 8 Word/ Range recognizers 8 Counter/Timers 4 TekLink Signals
30HSM (page 172)	High Speed Hardware Analysis	20 or 4 or 20 or 18	400 MHz 2 GHz 200 MHz 95 MHz	Transitional Transitional Dual Threshold Transitional Synchronous	24K 120K 12K 6K	15 Trigger Tests 4 Levels 2 Counter/Timers 4 Word Recognizers 4 TekLink Signals
30DSM (page 173)	Analog Waveform Analysis	1 or 2	400 MS/s 200 MS/s	NA NA	32K 16K	Edge: rising/falling External Trigger

**1 Channels can be doubled by welding two GPX modules in a 3002 or 3002E mainframe*
**2 Supports microprocessor clock rates up to 33 MHz*

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

GPX Logic Analyzers



Real-time PA provides you the capability to easily determine how to optimize your system for better performance.

IT ALL STARTS AT THE PROBE TIP

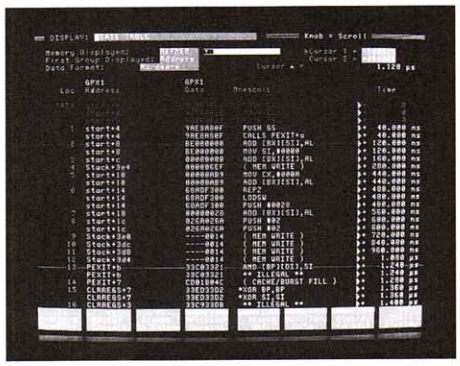
The GPX emphasizes a "single-probe-multi-measurement" connection so you can make a wide variety of measurements without changing probes or double-probing. The GPX offers a powerful simultaneous state and timing capability with two time-bases to acquire a signal both synchronously and asynchronously at the same time, through a single probe.

COMPREHENSIVE MICROPROCESSOR SUPPORT

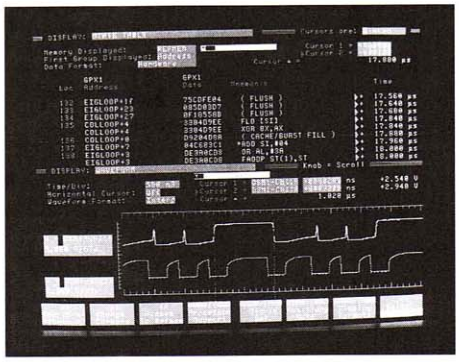
In addition to being a powerful general purpose logic analyzer, the GPX offers support for today's popular microprocessors including the 50 MHz 486, DSPs, microcontrollers and RISC chips. Its low load probing system (5 pF) and custom probe adapters allows you to look at all of the microprocessor's lines both synchronously and asynchronously at the same time. In addition, the GPX's 1 GHz timing channels are connected to the microprocessor's control lines to allow a detailed analysis of key signals.

TRIGGERING MADE EASY

The most difficult aspect of a logic analyzer for a new user is setting up the trigger. The GPX solves this problem by offering 27 pre-programmed trigger set-ups that can be used in the majority of cases. You can easily customize any of these set-ups for your specific application.



GPX offers 4 modes of disassembly: Hardware, Software, Control Flow, and Subroutine. All disassemblers include automatic fetch prediction, capability to display high level symbols, and automatic time-stamps for measuring time.

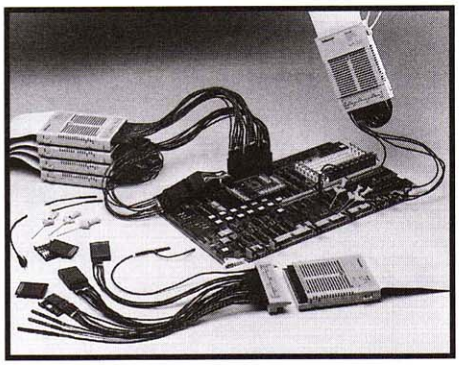


Complimentary modules are available such as a DSO (above) and a high speed module. Split screen displays allow you to view your data simultaneously, time-correlated.

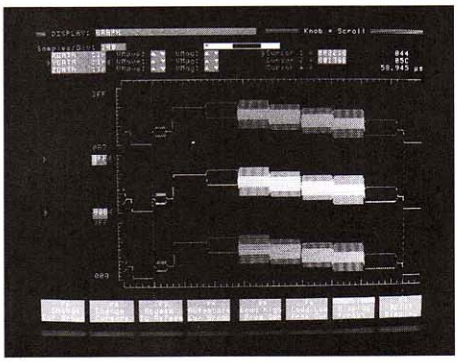
MULTIPLE DATA DISPLAYS

Acquiring data is just one half of the problem. For quick and accurate analysis you need to look at your data in a mode that makes the problem easy to find. The GPX offers a wide variety of displays:

- 4 Modes of disassembly with high level language symbols for software debug
- Graph Mode plots acquired data value vs. time which is useful for A/D and HDTV applications
- Real-Time Performance Analyzer histograms show you where your program is spending its time
- GPX's ROM emulator lets you examine and change memory for quick patches to your program



The GPX's probing is comprised of (4) 20 channel light weight probes. Eight channels can be grouped together in a podlet holder. Each podlet is 100 mil square and easily interfaces to a wide variety of testclips and probing accessories



With Graph Display, you can plot the "value" of your acquired data vs. memory location. You can simultaneously view up to 3 groups as separate, overlaid, or with an offset. Display features include autoscaling, interpolation (linear or sin(x)/x), and data as signed or unsigned.

REAL-TIME PERFORMANCE ANALYSIS

A unique feature to the 3000 series is real-time PA. The GPX offers 12 ranges (expandable to 48 ranges) that monitor your microprocessor's BUS activity in real-time - meaning that no BUS cycle is missed. Traditional statistical PAs sample the BUS missing significant amounts of activity. Real-time PA is crucial if you are looking for a random glitch or other single-shot anomaly.

Microprocessor Analysis

The 30MPX module provides the support you need for developing a microprocessor based design in one low cost module.

30MPX

- Combined State and Timing Analysis
- 96 State Channels, 8K Deep
- Support 8/16/32 Bit Devices up to 33 MHz
- 9 Transitional Timing Channels, 2K Deep
- 200 MHz Transitional Timing or 90 MHz Synchronous
- Real-time Performance Analysis

Microprocessor Analysis Module

The 30MPX module offers the functionality needed for designers of microprocessor based systems on a single, low cost module. Microprocessor analysis, timing analysis, real-time performance analysis and microprocessor control are combined on a single card.

The 30MPX provides 96 channels of state analysis. Each channel has an 8K memory depth making it ideal for tracing complex program flow and capturing both the cause and the visible effect of software problems.

MULTIPLE DISASSEMBLY FORMATS FOR RAPID ANALYSIS

Four disassembly display formats support rapid analysis of microprocessor activity. You can switch between hardware, software, control flow, or subroutine display without reacquiring data. These different display modes allow you to concentrate on the appropriate data display required to solve your problem.

SIMULTANEOUS SUPPORT FOR UP TO FOUR MICROPROCESSORS

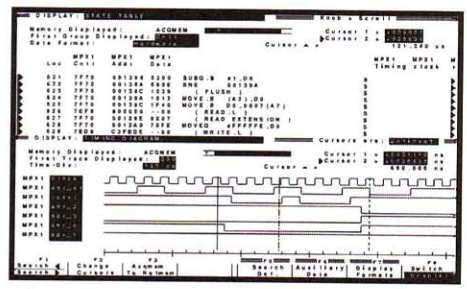
For analysis of multiple microprocessor based designs, up to four 30MPX modules can be used simultaneously. As data is acquired from each microprocessor, it is time-stamped and stored. You can then split the screen to display data from each processor. As you scroll the data from one processor, the data display for the second processor stays in sync. This powerful feature enables you to solve complex problems related to the interaction of multiple microprocessors.

200 MHZ TIMING ANALYSIS ON THE SAME MODULE

The 30MPX module provides 9 additional channels of 200 MHz transitional or 90 MHz synchronous acquisition with each channel storing 2K transitions.

Transitional storage only stores data when the state of the signal changes, rather than at every sample interval. The advantage of transitional storage is that you can capture long periods of time while maintaining maximum sampling resolution.

High speed timing analysis compliments the state analyzer by giving you detailed visibility of other parts of your circuitry such as control lines, I/O and clocks.



The 3000 Series split screen display can display both state and timing at the same time. The "link cursor" option links the two displays together so as one display scrolls, the second display stays in sync.

TIME CORRELATION TIES EVERYTHING TOGETHER

All data acquired by the 30MPX's state and timing sections (or from any other 3000 series module) is automatically time-stamped by the system's high speed master clock. This time stamp is used to time-correlate ALL of your data as it is displayed in the split screen display.

The advantage of time-correlation is that you can easily and accurately correlate the activity of the microprocessor to high speed activity of your other circuits.

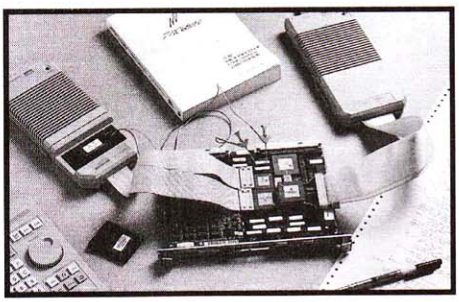
REAL-TIME PERFORMANCE ANALYSIS

The 30MPX offers real-time performance analysis capability similar to the 32GPX. Real-time PA gives you the ability to profile the performance of your software. A key aspect of REAL-TIME PA over the traditional statistical approach is that ALL activity is captured. No data is lost while the analyzer is processing the acquired data. This is especially vital in optimizing real-time embedded control systems or looking for single-shot events.

With real-time performance analysis you can identify where in your program you should focus your efforts to fine tune your system for its optimum performance.

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

Software/Hardware Integration



Connection to your prototype is a simple matter of plugging EPROM probe adapters into your ROM sockets.

The PDT Advantage

When logic analyzer users were asked what features they would most like to add to their logic analyzer, the majority answered that they would like a way to control the microprocessor. Tektronix responded to this challenge with the Prototype Debug Tool (PDT).

PDT adds ROM emulation capability to the 32GPX and the 30MPX modules through an innovative EPROM probe adapter (30RP2 probe). General Purpose PDT supports any microprocessor by plugging the 30RP2 probes into your system's EPROM sockets. With General Purpose PDT you can:

- Emulate your system EPROM
- Download code
- Set hardware breakpoints
- Patch EPROM memory
- Stop your application program.

To add microprocessor control to your 32GPX or 30MPX module, you simply add the appropriate number of 30RP2 EPROM probe adapters and PDT software (standard with the 30RP2).

SOFTWARE/HARDWARE INTEGRATION WITH PDT

Many people integrate their hardware and software by simply using a logic analyzer along with an EPROM burner. They burn an EPROM, plug it into their circuit, connect a state analyzer to the microprocessor, start their program with the reset button, and trace their program flow with the logic analyzer. For many applications this is a tedious but adequate process. With PDT, the above process can be improved by an order of magnitude without expensive new tools.

By adding the PDT option to your logic analyzer you can bring up new hardware and perform all of your initial hardware and software integration with a single instrument.

PDT allows you to download code and patch emulated EPROM memory. You can control your program from the GPX or MPX trigger machine by using the "Assert PDT Stop Line" connected to an interrupt source on your prototype.

INTEGRATION WITH OTHER PRISM MODULES

PDT links with all other parts of the system through TekLink. This means you can use PDT with the 30HSM High Speed Timing Analyzer or the 30DSM Digitizing Oscilloscope to bring up new boards and verify signal integrity. In addition you can use up to four 30MPX or 32GPX modules with PDTs to control up to four microprocessors at the same time.

The KEY advantages of PDT over other types of microprocessor debug tools is its real-time operation, high speed timing analysis, real-time performance analysis, and tight integration with other engineering tools, all in one system.

30MPX MICROPROCESSOR SPECIFIC PDT

The 30MPX offers an enhanced PDT for the 68000, 68020, 68030, and the 386. With these microprocessor specific PDTs you can do everything that the general purpose PDT can do plus:

- Set Software Breakpoints
- Single Step Code
- Memory Disassembly
- Examine/Change RAM Memory
- Examine/Change Registers
- Emulate EPROM Memory
- Simultaneously start LA and uP

To add microprocessor control to your 30MPX module, you simply add the appropriate number of 30RP2 EPROM probe adapters and PDT software (30DDxx). A KEY advantage of the PDT approach is that to change microprocessors you only need new PDT software. Your investment in hardware tools is preserved as you change processors.

PDT

- Adds ROM Emulation Capability
- Real-Time Operation
- Assembly Level Debug
- Ideal for ROM Based Systems Development
  - Device Drivers
  - Diagnostic Code
  - Boot Code
- Ideal for Bringing Up Prototypes
- Debug New Kernels

Low cost option to the 32GPX or 30MPX - ROM Emulation.

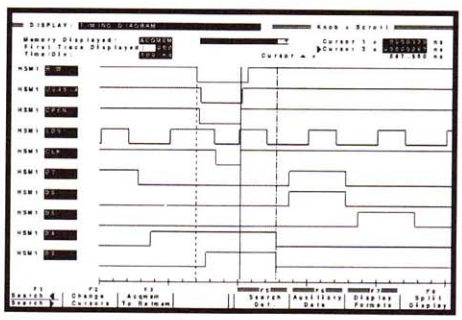
To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

High Speed Analysis

High Speed Acquisition Module for accurate timing analysis.

30HSM

- 2 GHz, 4 Channels
- 400 MHz, 20 Channels
- 95 MHz Synchronous, 18 Channels
- Dual Thresholds
- 24K Transitionally Stored Memory
- 15 Preset Trigger Tests
- 2.5 ns Glitch Detection



Sampling all 20 channels simultaneously at 2.5 ns, the 30HSM assures that you can make detailed timing measurements even if your design is based on the very newest logic families.

High-Speed Hardware Analysis

The 30HSM module is a complete high speed acquisition system for capturing and analyzing hardware faults in digital circuitry. A range of data acquisition modes, including 2 GHz transitional timing and Dual Threshold Mode, provide the ability to analyze a wide range of potential hardware problems.

The 30HSM's fault triggering lets you quickly locate hardware faults. Trigger selections include tests for set-up and hold time violations, pulse duration violations, and metastability. To save you time, these and other tests are pre-programmed in the 30HSM.

PROBLEMS DETECTED BY THE HSM

The many features of the 30HSM enables the design engineer to detect complex problems such as:

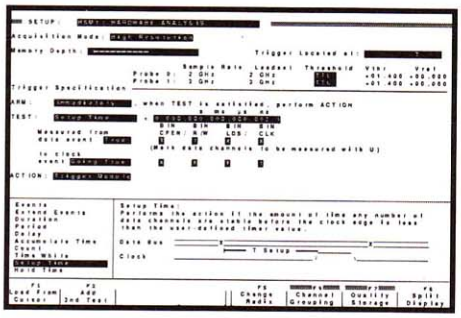
- Bus Contention
- Handshaking Errors
- DMA Problems
- Races & Hazards
- Glitches
- Setup & Hold Violations
- Propagation Delays
- Metastability
- Cross Talk
- Ringing

ACQUISITION MODES

The 30HSM incorporates four acquisition modes which provide you with the resources you need to efficiently solve the most demanding problems or make detailed measurements of your design's operation.

400 MHz High Resolution Mode

The high resolution mode provides 400 MHz timing (2.5 ns) across 20 channels. Each channel can record 24K transitions. This mode makes it easy to debug problems caused by race conditions, setup/hold time violations, and propagation delays.



Application specific triggering and context-sensitive HELP make using the 30HSM a breeze.

Dual Threshold Mode

The unique dual threshold mode provides 200 MHz timing (5 ns) across 20 channels. Each channel can record 12K transitions. This mode is uniquely suited to exposing difficult intermittent problems such as those caused by slow rise/fall times, bus contention, low drive or runt pulses, reflections, crosstalk, tri-state conditions, and excessive system noise.

2 GHz Mode

The 2 GHz mode provides 4 channels of 500 ps resolution for resolving very fine timing relationships. Each channel can record 120K transitions.

95 MHz Synchronous Mode

The synchronous mode provides 18 channels that can accept an external clock from the system under test up to 95 MHz. Each channel has 6K of memory for data storage.

TRANSITIONAL STORAGE

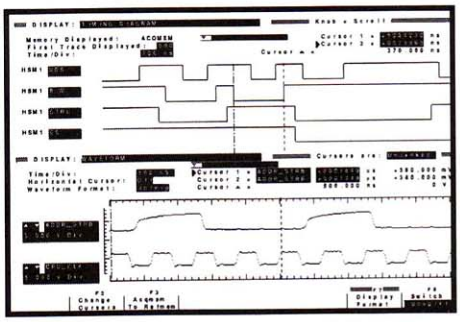
In timing mode the 30HSM stores data only when the state of the input signals change. This transitional storage can be contrasted with conventional storage where data is stored at every sample interval. By using transitional storage, the 30HSM enables you to capture long periods of time (up to 60 minutes) while maintaining maximum sampling resolution.

TRIGGERING

The 30HSM makes setting up triggers easy by providing 15 predefined trigger tests for measuring timing related problems. Trigger resources include four 20-bit word recognizers, two counter/timers, and four intermodule TekLink signals.

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

Waveform Analysis



Data acquired by any PRISM module is automatically time-correlated with all other data. Here the PRISM split screen display shows data acquired by the 30HSM correlated to signals acquired by the 30DSM.

Analog Problem Solving In A Digital Instrument

A powerful, multi-channel digital storage oscilloscope (DSO), the 30DSM has been tightly integrated into the 3000 Series logic analyzer. It provides highly accurate analog measurement capability to address the needs of engineers involved in the design and test of sophisticated digital electronic products.

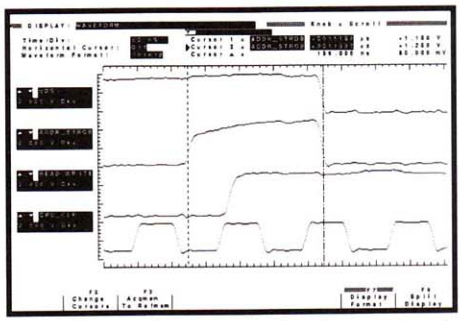
DESIGNED FOR THE DEMANDS OF TODAY'S HIGH-SPEED LOGIC FAMILIES

Each 30DSM contains two high-speed A/D converters and 32K of acquisition RAM. Measurement accuracy is insured by 8-bit vertical resolution, 350 MHz bandwidth triggering, user selectable interpolation and bandwidth limit filters, and a high-fidelity probe/attenuator combination. You can easily measure the worst-case propagation delay across a printed circuit board or make repeated measurements to determine the setup and hold margin of a memory system.

FLEXIBLE ACQUISITION MODES PUT YOU IN CONTROL OF YOUR MEASUREMENTS

You can select between the single channel, 400 MS/s acquisition mode with a 32K record length or the dual channel, 200 MS/s mode with a 16K record length. In the single channel acquisition mode, the 30DSM can acquire single shot events up to 100 MHz (50 MHz in the dual channel mode).

Multiple 30DSMs can be integrated into your 3000 series system to provide up to eight fully attenuated DSO channels. All channels are digitized simultaneously so you can determine exactly both the time and voltage relationships between them. Add a 30DSM to any 3000 series system to increase the general-purpose utility for troubleshooting both the digital and analog sections of your design.



Multiple waveforms can be freely moved and sized on screen. Not only can you see the time relationship between these waveforms, but the quality of the signals as well.

CURSOR MEASUREMENTS MAKE IT EASY FOR YOU TO SEE WHAT HAPPENED

Every waveform captured by the 30DSM can be displayed to nearly the full 14" height of the display. You can easily overlap signals by moving them up or down in the display field. Four waveforms can be displayed at one time, selectable from any input probe or saved reference waveforms. You can even display multiple copies of the same signal.

There are two on-screen measurement cursors that can have either a vertical or a horizontal orientation. The voltage and time at the position of each cursor is always displayed on screen. The cursors can be assigned to any of the displayed waveforms. As an example, you can assign Cursor 1 to Channel 1 and Cursor 2 to Channel 2 and then measure the difference in voltage between the waveforms at any instant in time.

TIME CORRELATED DATA TAKES THE PAIN OUT OF MIXED-MODE PROBLEM FINDING.

It's nearly impossible to troubleshoot today's complex digital designs using only an oscilloscope. The 3000 Series helps you overcome this limitation by combining the power of the 32GPX, 30MPX or 30HSM with the high-speed digitizing offered by the 30DSM. You will be able to trigger on, acquire, and display microprocessor execution, setup and hold time violations, or control line signal integrity. The system automatically correlates all acquired data, regardless of the acquisition module.

30DSM

- 400 MS/s Digitizing
- 100 MHz Single Shot Bandwidth
- 32K-bit Record Length
- 8-bit Vertical Resolution

Multi-channel Digital Storage Oscilloscope for solving tough analog problems.

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

Configurations

Multiple mainframes and options allow you to select the most appropriate configuration for your application.

3000 SERIES

- 40MB Hard Disk
- MS-DOS Compatible, 3 1/2 inch Disk
- Postscript/EPSON Printer Support
- Full Size QWERTY Keyboard
- RS-232 and GPIB Support

Multiple Mainframes to Meet Your Needs

The 3000 Series was designed with a flexible architecture which enables Tektronix to offer all of the capability of the application modules in a package that best fits your needs. The different packages are:

- 3002C – Benchtop, 2-slot color mainframe
- 3002P – Portable, 2-slot mainframe
- 3002E – Two slot expansion mainframe
- 3001 – Low cost portable system

3002C MAINFRAME

The 3002C is a two slot benchtop mainframe that can be extended to add two additional slots with the 3002E expansion mainframe. This unit features a full QWERTY keyboard, a high resolution 14 inches color display, 720KB MS-DOS compatible floppy, and a 40MB hard disk.

3002P MAINFRAME

The 3002P is a combination of the portability features of the 3001 with the expansion capability of the 3002C. The 3002P is identical to the 3002C except that the high resolution color CRT is replaced with a 9 inch high resolution flat panel display. The display folds down and is secured to the top of the mainframe and the keyboard is stored safely under the mainframe, making it easy to move from one location to another.

3002E EXPANSION MAINFRAME

The 3002E is a two slot expansion mainframe that contains a power supply and interconnect cables. This low cost expansion enables you to add two additional application modules to either a 3002 or 3001 mainframe.

3001 SYSTEMS

The 3001 is a low cost stand-alone mainframe that is factory configured with one application module. There are three versions available:

- 3001GPX – General Purpose and µP analysis
- 3001MPX – 8/16/32 bit µP analysis
- 3001HSM – High speed timing analysis

These traditional logic analyzers contain a 9 in. CRT, function key pads and control knob (a keyboard is optional), an optional 40 MB hard disk, and a MS-DOS compatible floppy.

For use in the lab, the 3001 can be expanded with a 3002E mainframe for an additional two slots.

3002 SYSTEMS

Eleven pre-configured 3002 systems are available. Each system can be expanded by adding the 3002E expansion mainframe for an additional two slots.

DIFFERENT MAINFRAMES, SAME USER INTERFACE

To make your design team more productive, the 3001 and 3002 configurations share the same user interface and operation. Thus, you can use a 3002 in the lab for design, and a 3001 in the field for repair without having to learn a new instrument.

HELP IS JUST A BUTTON AWAY

If you ever have a question about how a certain function works or what an option does, simply press the NOTES key and a detailed description will be displayed.

3000 SERIES SYSTEM SELECTION GUIDE

Product	Description	Module	Display	Mass Storage	Price
3001GPX	1 slot portable	1 32GPX	9 in. Mono	720 KB	**$8,995**
3001MPX	1 slot portable	1 30MPX	9 in. Mono	720 KB	**$6,995**
3001HSM	1 slot portable	1 30HSM	9 in. Mono	720 KB	**$8,995**
3002CG	2 slot system	1 32GPX	14 in. Color	40 MB/720 KB	**$13,995**
3002CGG	2 slot system	2 32GPX	14 in. Color	40 MB/720 KB	**$21,990**
3002CGH	2 slot system	1 32GPX, 1 30HSM	14 in. Color	40 MB/720 KB	**$19,995**
3002CGD	2 slot system	1 32GPX, 1 30DSM	14 in. Color	40 MB/720 KB	**$19,995**
3002CX	2 slot system	1 30MPX	14 in. Color	40 MB/720 KB	**$9,995**
3002CXX	2 slot system	2 30MPX	14 in. Color	40 MB/720 KB	**$14,995**
3002CH	2 slot system	1 30HSM	14 in. Color	40 MB/720 KB	**$9,995**
3002CHH	2 slot system	2 30HSM	14 in. Color	40 MB/720 KB	**$14,995**
3002CXH	2 slot system	1 30MPX, 1 30HSM	14 in. Color	40 MB/720 KB	**$14,995**
3002CXD	2 slot system	1 30MPX, 1 30DSM	14 in. Color	40 MB/720 KB	**$14,995**
3002CHD	2 slot system	1 30HSM, 1 30DSM	14 in. Color	40 MB/720 KB	**$14,995**

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

Configurations

ORDERING INFORMATION

Our most popular configurations are listed here. For complete ordering information please see configuration guide. pn. 5EA 8297-1 (U.S.) 5EW 8297-1 (International).

3001 SERIES LOGIC ANALYZERS

3001GPX
General Purpose and Microprocessor Analysis Instrument.....**$8,995**
Includes: 16-CH @ 1GHz Timing, 80-CH @ 200 MHz timing, 80-CH @ 80 MHz State, 4 P6490 Probes, and 720 KB floppy.

Opt. 1A – 32PA Performance Analysis Software.....**+$650**
Opt. 1K – Add QWERTY Keyboard.....**+$500**
Opt. 1M – Add 40 MB Hard Disk.....**+$950**

3001MPX
8/16/32 Bit Microprocessor Analysis Instrument **$6,995**
Includes: 96-CH state and 9-CH @ 200 MHz timing (req opt 1H), P6480 state probe w/o leadset, and 720 KB floppy.

Opt. 1A – 30DA01 Performance Analysis Software .....**+$650**
Opt. 1F – P6480 General Purpose Probe Adapter.....**+$450**
Opt. 1H – 1 P6486 Timing Probe.....**+$1000**
Opt. 1K – Add QWERTY Keyboard.....**+$500**
Opt. 1L – 1 P6486 High Performance Leadset.....**+$500**
Opt. 1M – Add 40 MB Hard Disk.....**+$950**

3001HSM
High Speed Acquisition Instrument **$8,995**
Includes: 20-CH @ 400 MHz, or 4-CH @ 2 GHz, or 20-CH @ 200 MHz dual threshold timing, 2 P6487 high-speed probes with standard leadsets, and 720 KB floppy.

Opt. 1K – Add QWERTY Keyboard.....**+$500**
Opt. 1L – Add two 400 MHz leadsets.....**+$1,000**
Opt. 4L – Add one 2 GHz leadset.....**+$1,200**
Opt. 5L – Add two 2 GHz leadsets .....**+$2,400**
Opt. 1M – Add 40 MB Hard Disk.....**+$950**
Opt. 2A – Add 18 CH 95 MHz synch mode (req 1L) .....**+$750**

PRECONFIGURED 3002 LOGIC ANALYZERS

3002CG
3002C M/F With 1 32GPX.....**$13,995**
Includes: 3002C, 14-inch color monitor, 40 MB HDD, 720 KB FDD, keyboard, (1) 32GPX, (4) P6490 & Performance Analysis SW.

3002CGG
3002C M/F With 2 32GPXs **$21,990**
Includes: 3002C, 14-inch color monitor, 40 MB HDD, 720 KB FDD, keyboard, (2) 32GPX, (8) P6490 & Performance Analysis SW.

3002CGH
3002C M/F W/32GPX & 30HSM **$19,995**
Includes: 3002C, 14-inch color monitor, 40 MB HDD, 720 KB FDD, keyboard, (1) 32GPX, (4) P6490 , (1) 30HSM, (2) P6487 & Performance Analysis SW.

3002CGD
3002C M/F W/32GPX & 30DSM **$19,995**
Includes: 3002C, 14-inch color monitor, 40 MB HDD, 720 KB FDD, keyboard, (1) 32GPX, (4) P6490, (1) 30DSM, (2) P6109B, & Performance Analysis SW.

3002CX
3002C M/F With 1 30MPX **$9,995**
Includes: 3002C, 14-inch color monitor, 40 MB HDD, 720 KB FDD, keyboard, (1) 30MPX, (1) P6480 & Performance Analysis SW.

3002CXX
3002C M/F With 2 30MPXs **$14,995**
Includes: 3002C, 14-inch color monitor, 40 MB HDD, 720 KB FDD, keyboard, (2) 30MPX, (2) P6480, & Performance Analysis SW.

3002CH
3002C M/F With 1 30HSM.....**$9,995**
Includes: 3002C, 14-inch color monitor, 40 MB HDD, 720 KB FDD, keyboard, (1) 30HSM, (2) P6487.

3002CHH
3002C M/F With 2 30HSMs **$14,995**
Includes: 3002C, 14-inch color monitor, 40 MB HDD, 720 KB FDD, keyboard, (2) 30HSM, (4) P6487.

3002CXH
3002C With 30MPX & 30HSM.....**$14,995**
Includes: 3002C, 14-inch color monitor, 40 MB HDD, 720 KB FDD, keyboard, (1) 30MPX,(1) P6480, (1) 30HSM, (2) P6487 & Performance Analysis SW.

3002CXD
3002C With 30MPX & 30DSM.....**$14,995**
Includes: 3002C, 14-inch color monitor, 40 MB HDD, 720 KB FDD, keyboard, (1) 30MPX, (1) P6480, (1)P6486, (1) 30DSM, (2) P6109B, & Performance Analysis SW.

3002CHD
3002C With 30HSM & 30DSM **$14,995**
Includes: 3002C, 14-inch color monitor, 40 MB HDD, 720 KB FDD, keyboard, (1) 30HSM, (2) P6487, (1) 30DSM, (2) P6109B

The above 3002 systems have options to substitute the color monitor with a flat panel display, add additional leadsets, and other options to customize the systems to your needs.

3002 SERIES MAINFRAMES

3002C
2-slot system Mainframe With Color Monitor.....**$6,000**
Includes: 14-inch color monitor, 40 Mbyte hard disk, 720 KB floppy, QWERTY keyboard.

3002P
2-slot system Mainframe W/EL Flat-Panel Display **$6,700**
Includes: 9-inch electro-luminescent flat panel display, 40 Mbyte hard disk, 720 KB floppy, QWERTY keyboard.

3002E
2-slot system Expansion Mainframe.....**$2,000**
Includes: 9-inch & 4-foot TEKLink cable, mainframe mounting plate.

INTERNATIONAL POWER PLUGS OPTIONS

Opt. A1 – Universal Euro: 220 V, 50 Hz.....**NC**
Opt. A2 – United Kingdom: 240 V, 50 Hz .....**NC**
Opt. A3 – Australian: 240 V, 50 Hz.....**NC**
Opt. A4 – North American: 240 V, 60 Hz.....**NC**
Opt. A5 – Switzerland: 220 V, 50 Hz.....**NC**

See Customer Information Section for additional description.

3002 SERIES INSTRUMENT MODULES

32GPX
General Purpose & Microprocessor Analysis Module.....**$7,995**
Includes: 4 P6490 probes and leadsets

Opt. 1A – 32PA Performance Analysis Software.....**+$650**
Opt. 2W– Add (1) welding connector.....**+$35**

30MPX
8/16/32 Bit Microprocessor Analysis Application Module **$6,000**
Includes: P6480 state probe w/o leadset.

Opt. 1A – 30DA01 Performance Analysis Software .....**+$650**
Opt. 1F – P6480 General Purpose Probe Adapter.....**+$450**
Opt. 1H – 1 P6486 Timing Probe.....**+$1000**
Opt. 1L – 1 P6486 high performance leadset.....**+$500**

Continued on next page.

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

Configurations

ORDERING INFORMATION

30HSM
High Speed Application Module **$6,000**
Includes: 2 P6487 with standard leadset.
Opt. 2A – 18 Ch 95 MHz sync mode adapter ..... **+$750**
Opt. 1L – Add two high performance leadsets ..... **+$1,000**
Opt. 4L – Add one 2 GHz leadset ..... **+$1,200**
Opt. 5L – Add two 2 GHz leadsets ..... **+$2,400**

30DSM
Digitizing Oscilloscope Module **$6,000**
Includes: Two P6109B – 10:1 probes.

WARRANTY-PLUS SERVICE OPTIONS
Contact your nearest Tektronix representative for available warranty options.

ADDITIONAL ACCESSORIES

P6490
32GPX Data Acquisition Probe **$1,000**

P6480
30MPX State Data Acquisition Probe w/o Lead **$750**
Opt. 1F – Add General Purpose Probe Adapter ..... **+$450**

P6486
High-Speed Data Acquisition Probe with Standard Leadset for 30MPX **$1,000**
Opt. 1L – Add one high performance leadset ..... **+$500**

P6487
High Speed Data Acquisition Probe with Standard Leadset for 30HSM **$1,100**
Opt. 1L – Add one high performance leadset ..... **+$500**
FasTrak – Micro Training Package **$450**
CenTrak – High Speed Demo Fixture **$450**

1200C01
RS-232 COMM Pack **$750**

30C02
GPIB COMM Pack **$850**

PROTOTYPE DEBUG TOOL SUPPORT PACKAGES

30RP2
General Purpose PDT w/ROM Probe **$2,000**
Opt. 01 – Add 24/28/32-Pin Gen. Purpose ROM Probe Adapter ..... **+$350**
Opt. 02 – Add 40-Pin DIP ROM Probe Adapter ..... **+$350**

30DD27
68000/10 PDT Software (30MPX only) **$1,500**

30DD31
68020 PDT Software (30MPX only) **$3,000**

30DD33
68030 PDT Software (30MPX only) **$3,000**

SOFTWARE

32DM02
8085 Disassembly Software, Socketed 40-pin DIP **$1,000**

32DM04
8086//8088/80C86/80C88 Disassembly Software, Socketed 40-Pin DIP **$1,500**

32DM06
80186/80188/80C186/80C188 Disassembly Software, Socketed 68-Pin PGA **$1,500**
Opt. 1S – Substitute Socketed 68-Pin PLCC ..... **NC**

32DM07
8031/8051 Disassembly Software, Socketed 40-Pin Dip **$1,000**

32DM08
80286/80C286 Disassembly Software, Supports Socketed 69-Pin PGA **$1,500**
Opt. 1S – Substitute Socketed 68-Pin PLCC ..... **NC**

32DM09
80386DX Disassembly Software, Socketed 132-Pin PGA **$2,000**
Opt. 1S – Substitute Soldered 132-Pin JEDEC PQFP (AMD Devices Only) ..... **NC**

32DM10
80386SX Disassembly Software, Soldered 100-Pin JEDEC PQFP **$2,000**

32DM12
80486DX/DX2/486SX/487SX Disassembly Software, Socketed 168-Pin PGA **$2,000**

32DM24
6809/6809E Disassembly Software, Socketed 40-Pin DIP **$1,000**

32DM27
68000/68010/68HC000/68HC001/68EC000 Disassembly SW, Socketed 64-Pin DIP (68000/010/HC000) **$1,500**
Opt. 1S – Substitute Socketed 68-Pin PGA (68000/010/HC000/HC001) ..... **NC**
Opt. 2S – Substitute Socketed 68-Pin PLCC (68EC000) ..... **NC**

32DM31
68020/68EC020 Disassembly Software, Socketed 114-Pin PGA (68020) **$2,000**
Opt. 1S – Substitute Socketed 100-Pin PGA (68EC020) ..... **NC**
Opt. 2S – Substitute Soldered 132-Pin JEDEC CQFP (68020) ..... **NC**

32DM33
68030/68EC030 Disassembly Software, Socketed 128-Pin PGA **$2,000**
Opt. 1S – Substitute Soldered 132-Pin JEDEC CQFP ..... **NC**

32DM34
68040/ECO40/LC040 Disassembly Software, Socketed 179-Pin PGA **$2,000**

32DM41
Z80 Disassembly Software, Supports Socketed 40-Pin DIP **$1,000**

32DM91
68HC11 Disassembly Software, Socketed 52-Pin PLCC **$1,000**

32DM92
68302 Disassembly Software, Socketed 132-Pin PGA **$1,500**
Opt. 1S – Substitute Soldered 132-Pin JEDEC CQFP/PQFP ..... **NC**

32DM93
68331/68332 Disassembly Software, Soldered 132-Pin JEDEC PQFP/CQFP **$2,000**
Opt 1A – Add Preconfigured Interface for Motorola M68331/68332EVS Evaluation Board **$750**

32DM96
68HC16 Disassembly Software, Soldered 132-Pin JEDEC PQFP/CQFP **$1,500**

32DM101
DSP56000/1/2 Disassembly Software, Socketed 88-Pin PGA (56000/1) **$2,000**
Opt. 1S – Substitute Soldered 132-Pin JEDEC CQFP (56000/1) ..... **NC**
Opt. 2S – Substitute Socketed 132-Pin PGA (56002) ..... **NC**
Opt. 3S – Substitute Soldered 132-Pin CQFP/PQFP (56002) ..... **NC**

32DM122
TMS32020/TMS320C25/TMS320C26 Disassembly Software, Socketed 68-Pin PGA **$1,500**
Opt. 1S – Substitute Socketed 68-Pin PLCC ..... **NC**

32PA
32GPX Performance Analysis Software **$650**

30DA01
30MPX Performance Analysis Software **$650**

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

Configurations

ORDERING INFORMATION

MICROPROCESSORS SUPPORT PACKAGES

30DM04
8086/88 SW and Probe Adapter, DIP Socketed **$1,150**
Opt. 1S – Substitute DIP Soldered ..... **NC**

30DM06
80186/188 SW and Probe Adapter PGA Socketed **$1,150**
Opt. 1S – Substitute PLCC Socketed ..... **+$500**
Opt. 2S – Substitute LCC Socketed ..... **+$400**
Opt. 3S – Substitute PLCC Soldered ..... **+$500**

30DM07
8031/51 SW **$800**

30DM08
80286 SW and Probe Adapter, PGA Socketed **$1,150**
Opt. 1S – Substitute PLCC Socketed ..... **+$500**
Opt. 2S – Substitute LCC Socketed ..... **+$400**
Opt. 3S – Substitute PLCC Soldered ..... **+$500**

30DM09A
80386 SW and Probe Adapter, PGA Socketed **$1,800**

30DM10
80386SX, 80376 SW and Probe Adapter,
3M PQFP Socketed **$1,800**
Opt. 3S – Substitute AMP PQFP Socketed ..... **+$225**

30DM27
68000/10 SW and Probe Adapter, DIP Socketed **$1,150**
Opt. 1S – Substitute DIP Soldered ..... **NC**
Opt. 2S – Substitute PGA Socketed ..... **NC**
Opt. 3S – Substitute PLCC Socketed ..... **+$800**
Opt. 4S – Substitute PLCC Soldered ..... **+$500**

30DM31
68020 SW and Probe Adapter, PGA Socketed **$1,800**

30DM33
68030 SW and Probe Adapter, PGA Socketed **$1,800**

30DM41
Z80 (8 MHz) SW and Probe Adapter, DIP Socketed **$800**
Opt. 1S – Substitute DIP Soldered ..... **NC**

30DM41F
Z80 (20 MHz) SW and Probe Adapter, DIP Socketed **$1,150**

30DM91
68HC11 SW and Probe Adapter,
52-PIN PLCC Socketed and Soldered **$800**

30DM92
68302 SW **$1,150**

30DM93
68331/332 SW **$1,800**

30DM993
CPU 32 SW **$1,800**

30DM101
56000/1 SW and Probe Adapter, PGA Socketed **$1,150**

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

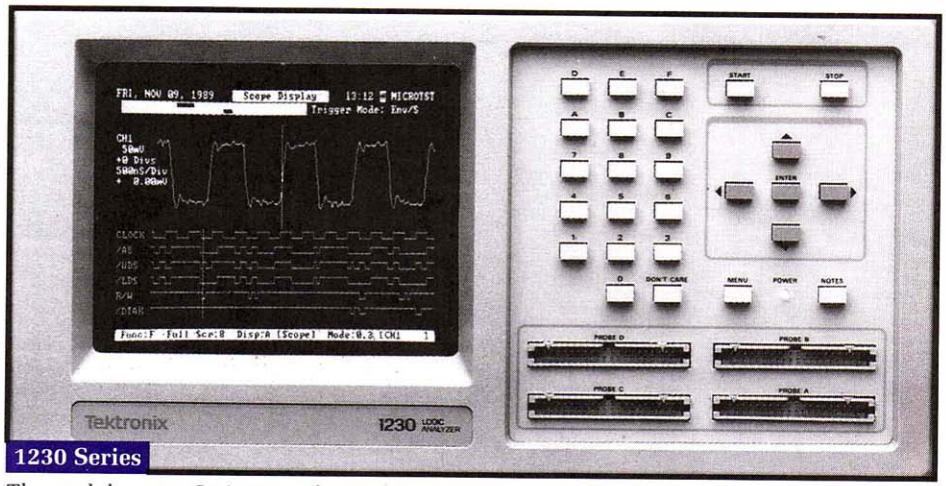
1230
1230B
1230D

Logic Analyzers

Expandable, affordable logic analyzers that grow with you.

1230/1230B/1230D

- 16 to 64 Channels
- 100 MHz Asynchronous Sampling
- 100 MS/s Digitizing Oscilloscope Card
- 25 MHz Synchronous Sampling
- 2K Memory Depth Per Channel
- Disassembly for 8 and 16 Bit Microprocessors
- 14–Level Triggering with Conditional Branching
- GPIB, RS-232C, Parallel Printer Options



1230 Series

The modular 1230 Series provides a strong growth path. You can expand the number of channels, add a Digitizing Oscilloscope module and microprocessor support probes as your testing needs change.

Flexibility You Will Put To Use Every Day

The 1230 is a series of modular, general-purpose logic analyzers that support hardware timing analysis, microprocessor disassembly, and system integration applications.

The 1230 provides 16, 25 MHz state channels or 8, 50 MHz, or 4, 100 MHz timing channels. Up to three 1230E1, 16 channel expander cards may be added to increase the number of channels. Refer to the configuration chart on the following page.

1230B – BATTERY POWER

The 1230B is a battery-powered version of the 1230. In addition to its self-contained, rechargeable battery, the 1230B also operates from 12 volts. The 1230B functions the same as the 1230 and uses the same probes and expansion modules, including the 1230DSM Digitizing Oscilloscope Module.

1230D ANALYZER AND OSCILLOSCOPE

The 1230D combines a 16-CH 1230 with a 2-CH, 100MS/s Digitizing Oscilloscope. It provides two versatile tools in one portable package. The 1230D can be expanded to 48 logic analysis channels.

BROAD MICROPROCESSOR SUPPORT

Optional disassembly probes let you conveniently attach to and monitor your microprocessor. Support is available for the 68000, 68HC11, Z80, 80286, 80386SX, and many others. Refer to the microprocessor selection guide on page180 for a complete list.

EASY TO LEARN AND USE

The 1230 Series features a large display and fast, interactive, pop-up menus. To save you time, most menu selections are made with a single keystroke. Menus are never more than one level deep, so you can select parameters quickly, without bottlenecks. Prompts at the bottom of each menu describe what to do, and a NOTES key provides context-sensitive, on-screen explanation.

Digitizing Oscilloscope

The 1230 Series combines a 100 MS/s digitizing oscilloscope and a logic analyzer in the same affordable instrument. Use the scope and logic analyzer separately, or interactively as an efficient system debug/characterization tool. The 1230DSM Digitizing Oscilloscope Module provides:

- 2 simultaneous channels
- 100 MS/s sampling rate
- 100 MHz analog bandwidth
- 8-bit vertical resolution
- 2048 samples per channel
- Repetitive sampling and signal averaging

POWERFUL TRIGGERING – A TEKTRONIX STANDARD

Like all Tektronix logic analyzers, the 1230 Series provides flexible, accurate triggering. Resources include 24 user-definable conditions, 14 triggering levels, two word recognizers per level, 5 ns glitch triggering, and more. All triggering resources are available for both timing and state analysis.

There are two trigger modes: Basic and Advanced. Having two modes to choose from lets you use the mode most suited to your application, without unnecessary complexity. Basic mode supports the most commonly used trigger setups. Advanced mode expands triggering capabilities with IF..THEN..ELSE instructions useful for creating two-way conditional branches and for qualifying data storage.

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

GPIB IEEE-488 — The 1230 Series with Opt. 03 complies with IEEE Standard 488.1-1987, and with Tektronix Standard Codes and Formats.

Logic Analyzers

FOUR NONVOLATILE 2K-DEEP MEMORIES
Four different memories, each with 2K bits/CH, are available for acquisition or reference data. All four memories are nonvolatile. Nonvolatile storage means that valuable test data is not accidentally lost. The last-used setup and acquisition data are restored on power-up, letting you begin where you left off.

MEMORY COMPARISON FUNCTIONS
The 1230 Series supports two comparison modes: manual and automatic. Manual-compare provides a single comparison of acquisition memory to reference memory. This is useful for basic pass/fail tests.

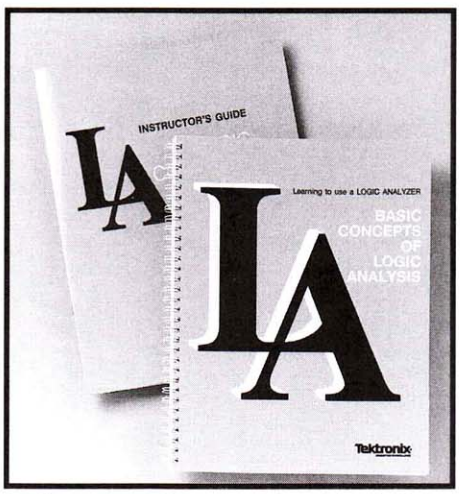
Auto-compare makes data acquisitions and comparisons repetitively without an operator present. Auto-compare is valuable in "babysitting" applications such as isolating intermittent malfunctions, freeing you from monitoring the test until the fault is detected.

In both compare modes, you can compare any two of the four memories. Differences are highlighted in the State Table.

REMOTE CONTROL FOR LOW-COST AUTOMATED TESTING
By adding an optional RS232 or GPIB communications interface to the 1230 Series, the analyzer can be controlled remotely from a computer keyboard or via a program written for the computer. This capability lets you turn the instrument into a low-cost automated test station.

The RS232 and GPIB interfaces also let you store unlimited memories and setups on your PC, and download them into the analyzer at any time.

Included with the RS232 Interface is software package S43R101. This software runs on IBM PC, XT, ATs (or compatibles) and provides an easy, fast method for transferring instrument setups and data over RS232. S43R101 also lets you create and run automatic, remote-controlled tests.

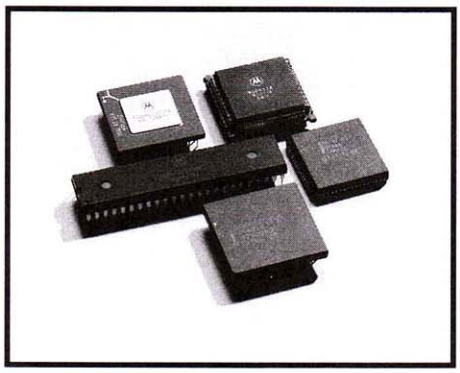


Self-paced training materials quickly build your skills.

The Complete Solution

EVERYTHING YOU NEED TO LEARN AND USE ANY 1230 SERIES INSTRUMENT IS STANDARD.
This includes the normal accessories you would expect: programmable-threshold acquisition probe, leadsets, grabber tips, and Operator's Manual. And there is a handy, pocket-sized quick reference guide included. Extensive instructional materials: training videotape, practice test circuit, and a workbook of application examples are also included at no additional cost.

TEACHING MATERIALS
Tektronix developed the Basic Concepts of Logic Analysis self-study workbook (LABASIC) for those who need to learn or teach logic analysis theory and techniques. This optional workbook contains theory, instructors guide, exercises using the 1230, and student examinations.



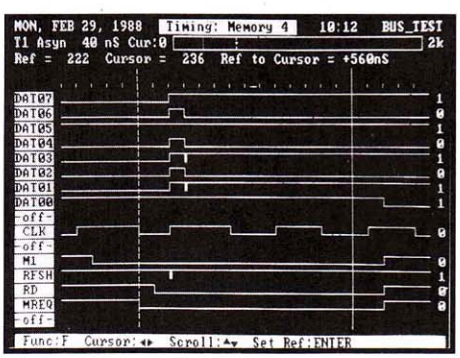
The 1230 Series supports an extensive list of popular microprocessors and micro-controllers.

Microprocessor Support

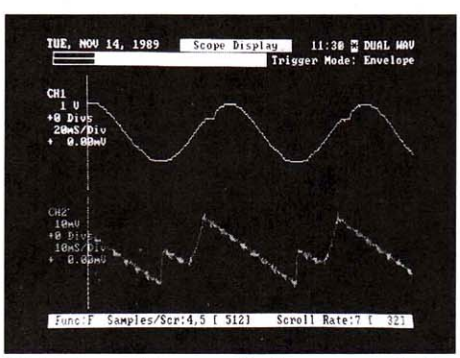
QUICK AND CONVENIENT CONNECTIONS
These compact microprocessor probes attach to the 1230 Series instruments in place of the standard acquisition probes. Each probe is preconfigured for fast, efficient connections to the specific microprocessor package (e.g., DIP, PGA, PLCC, or PQFP).

Disassembly probes that begin with the letters DP require the 1230DPA, a universal preprocessor.

AUTOMATIC MENU SETUP
You can completely set up all pertinent menus for the target microprocessor by uploading setups from the disassembly probe. All it takes is one keystroke at power-up. If desired, setups can then be customized for your specific application.



Timing diagram displays up to 16 traces at once. Intensified areas indicate glitches.



Digitizing oscilloscope displays are available for single or dual trace, full-screen trace, and mixed scope and timing diagram traces.

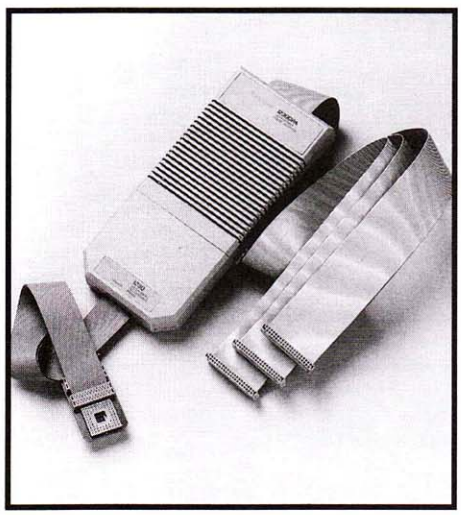
1230 SERIES CONFIGURATION CHART

	1230/B or /D	With one 1230E1	With two 1230E1s	With three 1230E1s
Channels at 25 MHz sync, async	16	32	48	64
Channels at 50 MHz async	8	16	24	32
Channels at 100 MHz async	4	8	12	16
Glitch channels	8	16	24	32
Time bases	1	2	3	4
Nonvolatile memories	4	4	4	4
Nonvolatile setups	8	8	8	8
Memory depth/channel	2048	2048	2048	2048
Compatible with 1230DSM	Yes	Yes	Yes	No

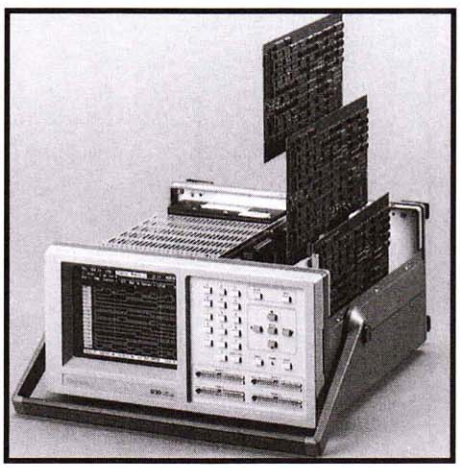
Continued on next page.

1230
1230B
1230D

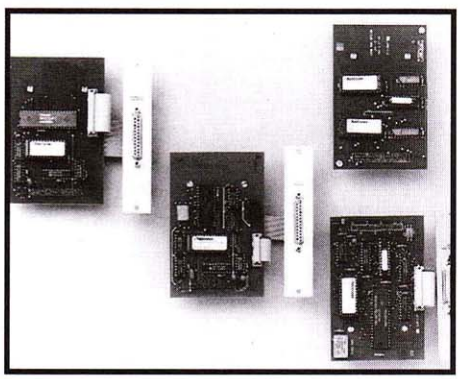
Logic Analyzers



Disassembly probes are compact and easy to connect.



Both the 1230DSM and 1230E1 cards install easily allowing you to reconfigure your instrument in less than five minutes.



Option boards provide a range of additional capabilities and install in minutes. Options include parallel printer port, RS232 and GPIB communication interfaces, and on-line notes in foreign languages.

FLEXIBLE VIEWING OF DATA

Acquired data can be viewed in either a state table, timing diagram, or disassembly format. When using disassembly format, two additional modes of display, Hardware and Software, are available.

Hardware mode shows all bus operations by displaying all machine cycles. Software mode shows only instruction cycles, much like an assembly listing.

EXTRA CAPABILITIES

Data searching functions, microprocessor-specific on-screen notes, fast scrolling, and the ability to jump to any memory location are available on all disassembly probes. For processors with pre-fetch queues, instructions that are fetched, but not executed, are clearly marked.

1230 SERIES MICROPROCESSOR AND BUS ANALYSIS SELECTION GUIDE

Microprocessor Type & Mfg.	Package Style	Minimum System Required	Order This Support Package	Price
Intel				
8085	DIP	1230C32	PM404	**$800**
8031/8051	DIP	1230C32	DP8031D*1	**$800**
8032/8052	DIP	1230C32	DP8031D*1	**$800**
8086/8088	DIP	1230C48	DP8086D*1	**$1,500**
80186/80188	PGA	1230C48	DP186P*1	**$1,600**
8096/80C196	PLCC	1230C48	DP96PL*1	**$1,600**
80286/80287	PGA	1230C48	DP286P*1	**$1,600**
80286/80287	PLCC	1230C48	DP286PL*1	**$1,600**
80386SX/80387SX	PQFP	1230C48	DP386SX*1,4	**$2,200**
Motorola				
6800/6802	DIP	1230C32	PM407	**$800**
6809/6809E	DIP	1230C32	PM406	**$800**
68HC11	all	1230C32	DPHC11*1	**$800**
68000/68010	DIP	1230C48	DP68KD*1	**$1,200**
68000/68010	PGA	1230C48	DP68KP*1	**$1,200**
Other				
Z80	DIP	1230C32	PM402	**$800**
6502/C02/C802	DIP	1230C32	PM403	**$800**
Buses				
GPIB	NA	Any 1230	DPGPIB*1, 2	**$800**
			1230 Opt. 07*3	**$195**
RS232	NA	Any 1230	A6740G	**$1,500**
STD	NA	1230C32	PM405	**$800**

**1 Requires 1230 Disassembly Probe Adapter (1230DPA).*
**2 Hardware interface and full disassembly.*
**3 Hardware interface only.*
**4 Socketed support only*

Logic Analyzers

STANDARD 1230 SERIES CONFIGURATIONS

Model Number	Recommended Application	Composed of:	Performance Overview	Price
Base Configurations				
1230	HW state/timing analysis	1 1230 Mainframe & (1) P6444 Probe	16-Ch 25 MHz synchronous 4-Ch 100 MHz asynchronous	**$2,995**
1230C32	HW state/timing analysis or 8-bit processor support	1 1230 Mainframe & (1) P6444 Probe 1 1230E1 & (1) P6444 Probe 1 Parallel Printer Port	32-Ch 25 MHz synchronous 8-Ch 100 MHz asynchronous	**$4,325**
1230C48	HW state/timing analysis 8- or 16-bit processor support	1 1230 Mainframe & (1) P6444 Probe 2 1230E1 & (2) P6444 Probes 1 Parallel Printer Port	48-Ch 25 MHz synchronous 12-Ch 100 MHz asynchronous	**$5,525**
1230C64	HW state/timing analysis or 8- or 16-bit processor support	1 1230 Mainframe & (1) P6444 Probe 3 1230E1 & (3) P6444 Probes 1 Parallel Printer Port	64-Ch 25 MHz synchronous 16-Ch 100 MHz asynchronous	**$6,725**
Battery Operated Configurations				
1230B	HW state/timing analysis	1 1230B Mainframe & (1) P6444 Probe	16-Ch 25 MHz synchronous 4-Ch 100 MHz asynchronous	**$4,995**
1230B32	HW state/timing analysis or 8-bit processor support	1 1230B Mainframe & (1) P6444 Probe 1 1230E1 & (1) P6444 Probe 1 Parallel Printer Port	32-Ch 25 MHz synchronous 8-Ch 100 MHz asynchronous	**$6,325**
1230B48	HW state/timing analysis or 8- or 16-bit processor support	1 1230B Mainframe & (1) P6444 Probe 2 1230E1 & (2) P6444 Probes 1 Parallel Printer Port	48-Ch 25 MHz synchronous 12-Ch 100 MHz asynchronous	**$7,525**
1230B64	HW state/timing analysis or 8- or 16-bit processor support	1 1230B Mainframe & (1) P6444 Probe 3 1230E1 & (3) P6444 Probes 1 Parallel Printer Port	64-Ch 25 MHz synchronous 16-Ch 100 MHz asynchronous	**$8,725**
Configurations Including a Digitizing Oscilloscope Module				
1230D	HW state/timing analysis or system integration	1 1230 Mainframe & (1) P6444 Probe 1 1230DSM & (2) P6109 Probes	16-Ch 25 MHz synchronous 4-Ch 100 MHz asynchronous 2-Ch 100MS/s Digitizing Scope Module	**$5,990**
1230D32	HW state/timing analysis, system integration, or 8-bit processor support	1 1230 Mainframe & (1) P6444 Probe 1 1230E1 & (1) P6444 Probe 1 1230DSM & (2) P6109 Probes 1 Parallel Printer Port	32-Ch 25 MHz synchronous 8-Ch 100 MHz asynchronous 2-Ch 100MS/s Digitizing Scope Module	**$6,990**
1230D48	HW state/timing analysis, system integration, or 8-bit or 16-bit processor support	1 1230 Mainframe & (1) P6444 Probe 2 1230E1 & (2) P6444 Probes 1 1230DSM & (2) P6109 Probes 1 Parallel Printer Port	48-Ch 25 MHz synchronous 12-Ch 100 MHz asynchronous 2-Ch 100MS/s Digitizing Scope Module	**$8,190**

Continued on next page.

1230
1230B
1230D

Logic Analyzers

ORDERING INFORMATION

ADDITIONAL ACCESSORIES FOR 1230 SERIES SYSTEMS

Opt. 01 – RS-232 interface and S43R101 PC S/W ..... **+$495**
Opt. 02 – Parallel printer port ..... **+$195**
Opt. 03 – GPIB interface ..... **+$695**
Opt. 04 – International notes ..... **+$150**
(English, German, French, French Canadian, Dutch, Spanish, and Italian)
Opt. 05 – Rackmount (1230 and 1230D only) ..... **+$495**
Opt. 06 – Accessory bag ..... **+$65**
Opt. 07 – GPIB acquisition leadset ..... **+$195**
Opt. 09 – International notes II (English, Danish, Finnish, Norwegian, and Swedish) ..... **+$150**
Opt. 21 – Service manual ..... **+$200**
Opt. 22 – Service maintenance kit ..... **+$1,500**
Opt. 23 – Substitute VHS-PAL video tape ..... **NC**

1230 SERIES ACQUISITION MODULES

1230E1
16 CH Expansion Card. **$1,200**
Includes: (1) P6444 probe, leadsets and grabbers

1230DSM
100 MS/s Digitizing Oscilloscope Card. **$2,995**
Includes: (2) P6109 probes and operator's manual

RELATED PRODUCTS

P6444
16-CH programmable threshold probe **$700**

S43R101
1230/PC RS232 application software **$95**

K217
Instrument cart **$695**
Opt. 01 – Brown finish (matches 1230) ..... **NC**
Securing strap – Order 346-0070-03 ..... **$55**
LABASIC Concepts of Logic– Analysis Workbook **$15**
LAGUIDE Concepts – Instructor's Guide **$10**

INTERNATIONAL POWER PLUG OPTIONS

Opt. A1 – Universal Euro: 220 V, 50 Hz ..... **NC**
Opt. A2 – United Kingdom: 240 V, 50 Hz ..... **NC**
Opt. A3 – Australian: 240 V, 50 Hz ..... **NC**
Opt. A4 – North American: 240 V, 60 Hz ..... **NC**
Opt. A5 – Switzerland: 220 V, 50 Hz ..... **NC**

See General Customer Information Section for additional description.

WARRANTY-PLUS SERVICE OPTIONS

All 1230 Series products are covered by a one-year warranty.

Opt. M9 – Repair Protection
1230 ..... **+$80**
1230C32 ..... **+$160**
1230C48 ..... **+$240**
1230C64 ..... **+$320**
1230B ..... **+$140**
1230B32 ..... **+$220**
1230B48 ..... **+$300**
1230B64 ..... **+$380**
1230E1 ..... **+$80**

Traditional Acquisition Probes –
(Data: 16, Clock:2, Qual: 1). Order P6444 ..... **$700**
Cart – Order K217S **$780**
Rackmount Kit – For standard 19 in. rack. Order 1230F05 ..... **$450**

DISKETTES

5.25 in. Floppy Disks – Order 119-1583-01 ..... **$36**
360K 5.25-inch, Box of 10.
5.25 in. Floppy Disks – 1.2 M, 5.25-inch, Box of 10 ..... ***1**
3.5 in. Floppy Disk – Order 119-3136-00 ..... **$6**
720K, 3.5-inch, Each.

CABLES

RS-232 Cable – Order 012-0911-00 ..... **$100**
Used with DAS9200 mainframe to 9201T display or printer and communications interface. Male-to-female, 20 inch, wires: 1-1, 2-2, 4-4, 5-5, 6-6, 7-7, 8-8, 11-11, 12-12, 15-15, 17-17, 19-19, 20-20, 22-22.

Null Modem Cable – Order 012-0997-00 ..... **$100**
Used with PRISM 1200C01 Serial Printer Interface. Male-to-Female, 60 inch, wires: 1-1, 2-3, 3-2, 4-8, 5-8, 6-20, 7-7, 8-4, 8-5, 20-6.

Parallel Interface Cable – Order 012-0997-00 ..... **$100**
Two meter, for centronix-type printer interface.

GPIB Cable – Order 012-0630-03 ..... **$125**
Two meter, shielded.

Probe Extender Cable – Order 012-1012-01 ..... **$155**
Male-to-female, 6 ft., 34-positions double-row connectors. Compatible with P6463 & P6463A.

Flat Cable Mounts – Order 343-1048-00 ..... **$0.95**
Adhesive Back for securing and organizing probes with flat ribbon cables.

**1 Contact your local sales office for price information.*

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

GPIB IEEE-488 — The 1230 Opt. 03 Series complies with IEEE Standard 488.1-1987, and with Tektronix Standard Codes and Formats.

Probes and Leadsets

Logic Analyzer Probes and Leadsets

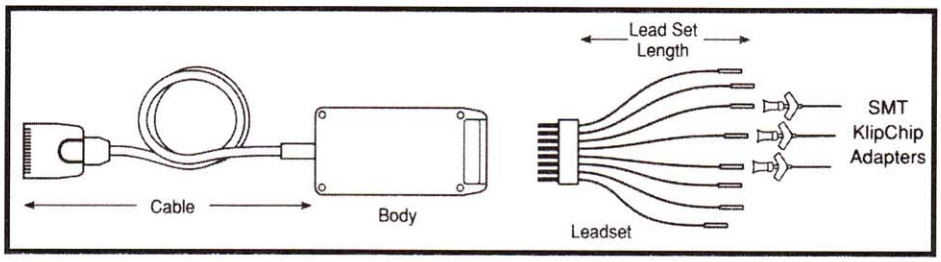


FIGURE 1: TRADITIONAL PROBE TYPE

Traditional Acquisition Probe	Probe Price	For Use With	OUTPUTS DNRZ	Clock	RZ/R1	Lead set Part Number	Available*1	Leadset Length	Leadset Price	Additional Information
P6444	**$700**	1230, 1230B, 1230D 1230E1	16	2	1	012-1230-01	Standard	10 in.	**$220**	Black Ends
						174-1265-00	Standard	10 in.	**$30**	Red Ends
						174-1266-00	Standard	10 in.	**$30**	White Ends
P6460	**$750**	DAS9200 92A16, 92A16E 92S16, 92SX109 DAS9100 91A24, 91AE24 1240, 1241 1240D1, 1240D2	8/9	1	1/0	012-0747-00	Standard	10 in.	**$40**	
						012-0987-00	Optional	5 in.	**$37**	

Traditional Pattern Generator Probe	Probe Price	For Use With	OUTPUTS DNRZ	Clock	RZ/R1	Lead set Part Number	Available*1	Leadset Length	Leadset Price
P6463A	**$1,000**	DAS9200 92S16, 92S32	16/9	1		012-1236-10	Standard	12 in.	**$160**
						012-1236-20	Optional	14 in.	**$175**

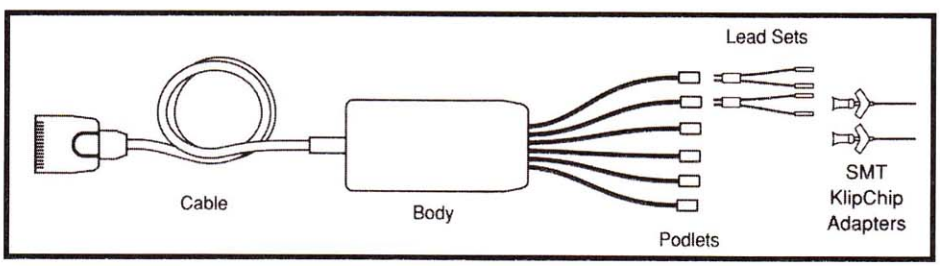


FIGURE 2: ACTIVE PODLET PROBE TYPE

Podlet Acquisition Probes	Probe Price	For Use With	INPUTS Data	Clock	Qual	Leadset Part Number	Available*1	Leadset Length	Leadset Price	Additional Information
P6461	**$1,600**	DAS9200 92A16, 92A16E	8	1	1	196-3047-00	Standard	3 in.	*2	Ten required per probe
P6461E	**$1,400**	DAS9200 92A16, 92A16E	8			196-3047-00	Standard	3 in.	*2	Eight required per probe
P6464	**$1,400**	DAS9200 92S16, 92S32 92SX109, 92SX118 DAS9100 91S16, 91S32	9	1		196-2963-00	Standard	3 in.	**$12**	Twelve required per probe
			8	1	1					
P6465	**$1,700**	DAS9200 92S16, 92S32	8	1	1	196-2963-00	Standard	3 in.	**$12**	Twelve required per probe

**1 Standard indicates that this leadset is sold as part of the product. This is the part you need to buy as a direct replacement. Optional indicates that the part can be substituted for the original part and varies in some way. i.e., longer .*
**2 Contact your local sales office for price information.*

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

Probes and Leadsets

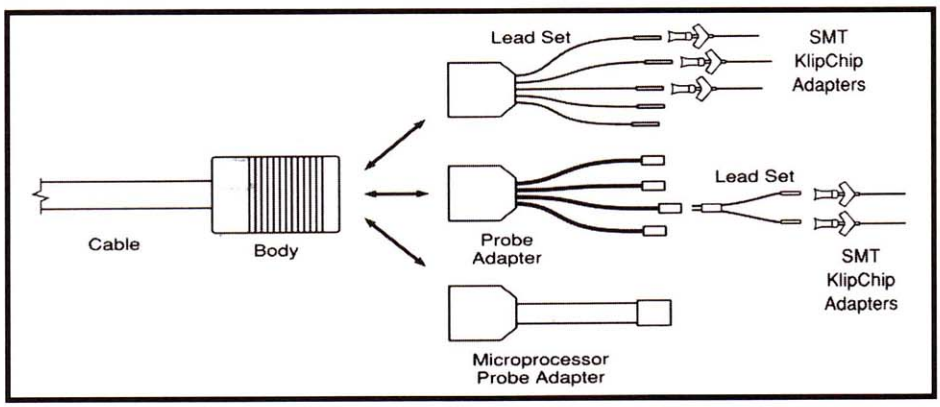


FIGURE 3: BUFFER PROBE TYPE

Acquisition Probes	Probe Price	For Use With	INPUTS Data	Clock	Qual	Leadset Part Number	Available*1	Leadset Length	Leadset Price	Additional Information
P6480	**$750**	PRISM 3000 30MPX 3001MPX	96	3	5	012-0747-00	Standard	10 in.	**$44**	30MPX or 3001MPX State Probe
P6486	**$1,000**	PRISM 3000 30MPX 3001MPX	10			012-1230-01	Standard	10 in.	**$220**	30MPX or 3001MP X Timing Probe
						012-1231-01	Optional	10 in.	*2	
P6487	**$1,100**	PRISM 3000 30HSM 3001HSM	10	4	4	012-1230-01	Standard	10 in.	**$220**	2 leadsets per 30HSM or 3001HSM.
			10	4	4	012-1231-01	Optional	10 in.	*2	400 MHz Probe Adapter
			2			012-1277-01	Optional	12 in.	**$1,320**	2 GHz Probe Adapter
Buffer Probe		DAS9200								
	NA	92A60, 92A60D	60	4	4	012-1165-00	Standard	10 in.	**$545**	
	NA	92A90, 92A90D	90	4	4	012-1165-00	Standard	10 in.	**$545**	

**1 Standard indicates that this leadset is sold as part of the product. This is the part you need to buy as a direct replacement. Optional indicates that the part can be substituted for the original part and varies in some way. i.e., longer .*
**2 Contact your local sales office for price information.*

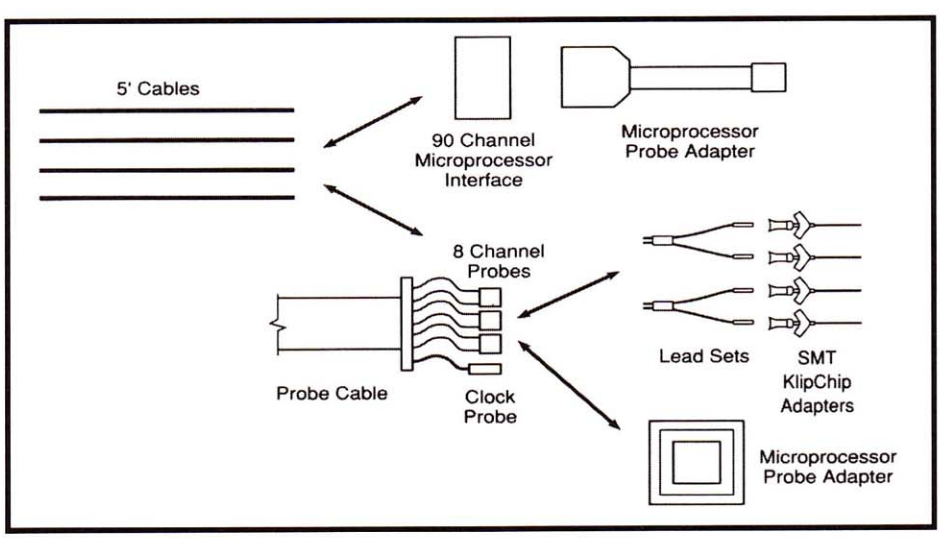


FIGURE 4: PASSIVE PODLET PROBE TYPE

ORDERING INFORMATION

100 Channel Probe Set – Order 010-0492-00 ..... **$4,345**
Includes: 96 data (organized as twelve 8-CH probes) & 4 clock probes. Does not include leadsets or KlipChips.

25 Channel Probe Set – Order 010-0508-00 ..... **$1,045**
Includes: 24 data (organized as three 8-CH probes) & 1 clock probe. Includes leadsets and KlipChips.

8 Channel Leadset – Pkg. of 12. Order 020-1919-00 ..... **$600**

Single Channel Clock Leadset – Pkg. of 12.
Order 020-1888-00. ..... **$95**

Dual Lead SMT KlipChip™ Adapters – Pkg. of 12
Order 020-1386-01. ..... **$46**

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

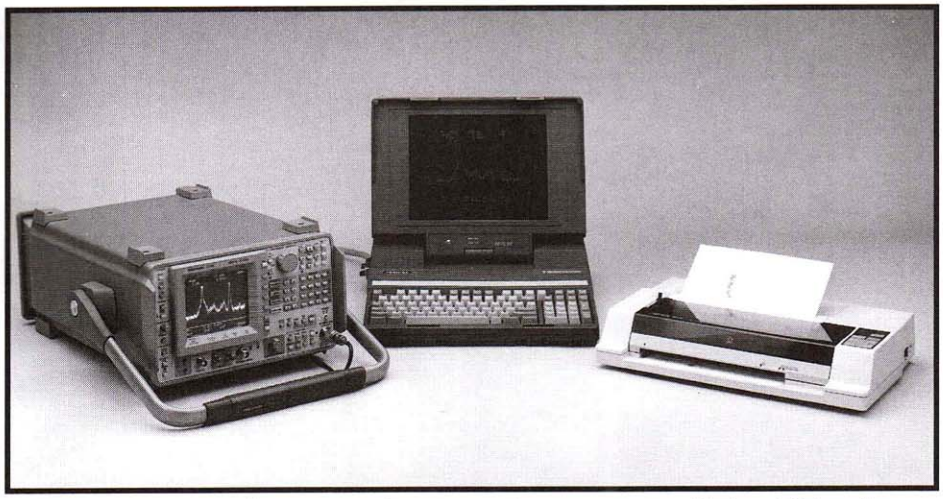
Microwave and RF Spectrum Analyzers

Tektronix Spectrum Analyzers and Ancillary Products–Unsurpassed Performance Values

Tektronix spectrum analyzers give you more for your money–for unexcelled performance at every frequency and price range. From 100 Hz to 325 GHz, Tektronix spectrum analyzers are available in portable, and rackmount configurations and satisfy the diverse needs of research, design, equipment maintenance, and production. Each analyzer is fully programmable (2711 programmable with Option 03 or 08) so you can automate complex measurements–on RF and microwave component or system production testing. Tektronix also offers application Software.

The new 2790 Series user interface takes accessible performance to a higher level, satisfying the needs of the Telecommunications, Avionics, and Consumer Electronics industries.

The new Tektronix 2714 Cable TV Spectrum Analyzer automatically makes all commonly needed cable TV spectrum measurements from simple, on-screen menu selections. Accompanying PC-based software allows the 2714 to be configured to automatically make groups of measurements and store the results. The stored results can later be transferred to a PC for archiving or report generation.



Tektronix Spectrum Analyzers can make automated measurements with the addition of a computer, appropriate Tektronix-supplied software, and a variety of available peripherals and accessories.

CONTENTS

MICROWAVE SPECTRUM ANALYZERS

2784 100 Hz to 40 GHz, Portable.....187
2782 100 Hz to 33 GHz, Portable.....187
2794 10 kHz to 21 GHz, Portable.....193
2792 10 kHz to 21 GHz, Portable.....193
2797 100 Hz to 7.1 GHz, Portable.....193

RF-SPECTRUM ANALYZERS

2795 100 Hz to 1.8 GHz, Portable.....193
2712 9 kHz to 1.8 GHz, Portable.....201
2711 9 kHz to 1.8 GHz, Portable.....201

CATV MEASUREMENT-SPECTRUM ANALYZER

2714 9 kHz to 1.8 GHz, Portable.....205

EMC MEASUREMENTS

27120 EMC Measurement System.....211
S26EM00 EMI Prequalification Software.....212
S26EM12 Commercial EMI Test Software.....212
2706 Stepping RF Preselector.....213
EMI Ancillary Devices.....214

WAVEGUIDE MIXERS

WM 782 Series.....192
WM 780 Series.....199

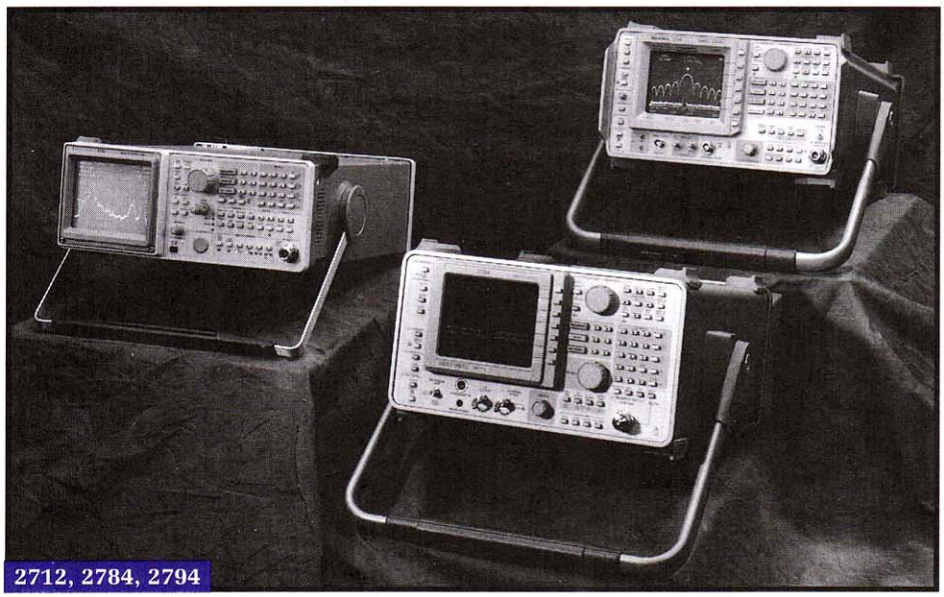
SOFTWARE

GRASP General RF Applications.....209
Utility Software for 2784/2782.....209
RSM Remote Site Monitoring.....209
Utility Software for 2712/2711.....209

ANCILLARY INSTRUMENTS

TR503 Tracking Generator.....200
1405 TV Sideband Adapter.....200
2705 Battery Pack.....215
2704 Inverter.....215

Microwave and RF Spectrum Analyzers



Tektronix offers a wide variety of Spectrum Analyzers for any measurement need. Shown above from left to right: 2712 Low-Cost Portable Spectrum Analyzer, 2784 Premium Performance Microwave Spectrum Analyzer, and 2794 Rugged Portable Spectrum Analyzer.

SPECTRUM ANALYZER SELECTION GUIDE

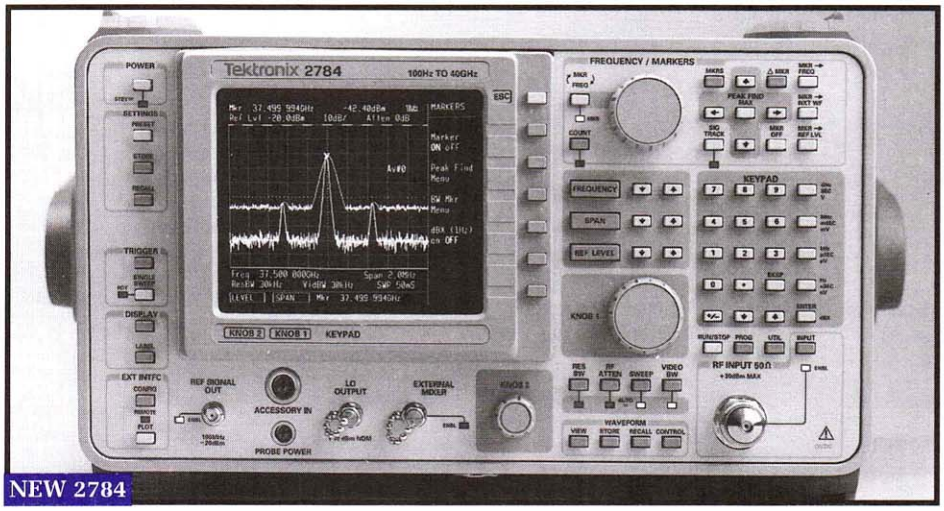
	2711	2712	2714	2792	2794	2797/2795	2784/2782
Coaxial Frequency Range	9 kHz to 1.8 GHz	9 kHz to 1.8 GHz	9 kHz to 1.8 GHz	10 kHz to 21 GHz	10 kHz to 21 GHz	100 Hz to 7.1 GHz (2797) 100 Hz to 1.8 GHz (2795)	100 Hz to 40 GHz (2784) 100 Hz to 33 GHz (2782)
Resolution Bandwidth Range	3 kHz to 5 MHz	300 Hz to 5 MHz*	300 Hz to 5 MHz	1 kHz to 3 MHz	10 Hz to 3 MHz	10 Hz to 3 MHz	3 Hz to 10 MHz
Sensitivity (Min RBW)	–117 dBm	–127 dBm	–80 dBmV	–110 dBm	–134 dBm	–130 dBm (2797) –131 dBm (2795)	–135 dBm
Phase Noise 1 GHz Center Frequency	–100 dBc/Hz @90 kHz offset	–90 dBc/Hz @9 kHz offset	–90 dBc/Hz @9 kHz offset	–103 dBc/Hz @30 kHz offset	–105 dBc/Hz @30 kHz offset	–105 dBc/Hz @30 kHz offset	–105 dBc/Hz @10 kHz offset (to 21 GHz)
Compression–to–Noise Dynamic Range	102 dB	112 dB	112 dB	110 dB	134 dB	130 dB	140 dB
Frequency Reference Aging Rate	1×10^{-5} per year	2×10^{-6} per year	2×10^{-6} per year	2×10^{-9} per day (Opt. 03)	1×10^{-9} per day	1×10^{-9} per day (2797 Opt. 02)	7×10^{-9} per day
Residual Spurious Responses	–100 dBm	–100 dBm	–51 dBmV	–95 dBm	–100 dBm	–100 dBm	–100 dBm
Signal to Third Order IM Dynamic Range							
1 MHz to 1.8 GHz	76 dB	76 dB	76 dB	76 dB	90 dB	100 dB (2797) 90 dB (2795)	100 dB (1 MHz to 6.5 MHz)
1.7 GHz to 21 GHz				>100 dB	>100 dB	>100 dB 1.7 to 7.1 GHz (2797 only)	>120 dB 6.5 to 40 GHz (2784) 6.5 to 33 GHz (2782)

**200 Hz to 5 MHz with EMC option.*

Spectrum Analyzers

Premium Performance Microwave Portable with Ruggedized Color Display

2782
2784



2782/New 2784 Spectrum Analyzers

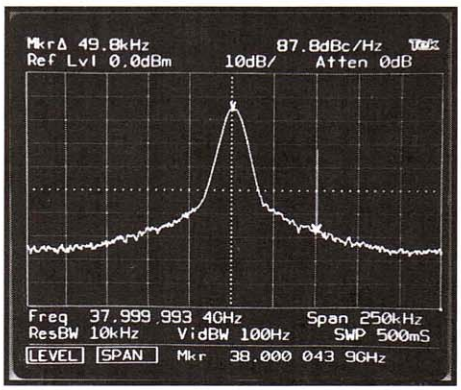
The Tektronix 2782 and 2784 offer leadership measurement performance, not just through minor enhancements, but by truly extending the state of the art. For example, the 40 GHz (33 GHz, 2782) coaxial input gives you more frequency range without resorting to external mixers. And you can see it all with the full-range 0 Hz to 40 GHz (33 GHz, 2782) sweep.

Whatever you need to measure, from close-in phase noise to demodulated pulsed RF, the 2782 and 2784 provide the capabilities – such as substantially better phase noise, and resolution bandwidth selections from 3 Hz to 10 MHz. This is further backed with standard-setting dynamic range and improved sensitivity from direct fundamental mixing to 28 GHz, plus a host of other performance firsts. For example, a +15 dBm TOI, a 0 dBm 1-dB compression point, and a compression-to-noise dynamic range of more than 100 dB at 40 GHz.

When you need to go above 40 GHz (33 GHz 2782) and external mixers are used, the 2782 and 2784 provide as much as 25 dB better measurement sensitivity than ever before possible. Set-up is simple as well. All you need is one cable and the WM782 Waveguide Mixers and you are set; you don't even have to peak these mixers.

SOFT KEY, MENU, AND MACRO CONVENIENCE

The 2782 and 2784 are rich in measurement features that are quickly and easily accessible through softkeys and menus that rarely go three deep. Often, your most frequently used feature can be assigned to one of two soft knobs for immediate access and control. Additionally, you can store front-panel keystroke sequences to simplify complex measurements, or even create single-key executable macros for the most complex applications.



HIGHLY EFFICIENT SYSTEMS COMPONENT

With full programmability and two GPIB ports, the 2782 and 2784 offer a new level in systems convenience and efficiency. For example, the 2782 and 2784 can communicate with the system host on one GPIB port and control a synthesizer on its other port. The host never has to deal with the synthesizer. The measurement host can be unburdened even further by downloading measurement-specific macros and key sequences to the 2782 and 2784. And with its small size, the 2782 and 2784 provide more performance in less rack space than any other spectrum analyzer on the market.

Continued on next page.

2782/2784

- 100 Hz to 40 GHz (33 GHz, 2782) Coaxial Frequency Range
- External Waveguide Mixer Support to 325 GHz
- Full-range Sweep from 0 Hz to 40 GHz (33 GHz, 2782)
- Resolution BW from 3 Hz to 10 MHz in a 1, 3, 10 Sequence
- 100 dB Display Dynamic Range
- Phase Noise Performance as Low as –105 dBc/Hz at 10 kHz Offset up to 21 GHz
- Mixer Input Level Decoupling from RF Attenuator by up to 30 dB
- Intelligent Markers/ Signal Processing: Search, Sort, and Mark CW, Pulse, or All Signals
- Exclusive Occupied Bandwidth Mode
- Signal Tracking
- Built-in 100 Hz to 1.2 THz Frequency Counter with frequency measurement accuracy of ≤400 Hz at 40 GHz
- Fully Programmable with Two GPIB Interfaces
- Built-in Automation
- Macro Downloading to 40K of NVRAM
- Store up to 20 Front-Panel Key Sequences
- Store up to 20 Waveforms with Readout Information
- Store up to 20 Instrument States

For the most demanding applications in the field or lab: Digital Microwave Radio, Satellite Communication, Microwave and RF Source Design, Avionics, Millimeter Wave R&D.

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

GPIB IEEE-488

The 2782 and 2784 complies with IEEE Standard 488.1-1987, and with Tektronix Standard Codes and Formats.

Spectrum Analyzers

Premium Performance Microwave Portable with Ruggedized Color Display

Characteristics

Except as noted, the following tables of electrical characteristics and features apply after a 30-minute warm-up.

ELECTRICAL CHARACTERISTICS

Direct coaxial input for the 2782 applies to 33 GHz. All performance specifications from 33 GHz to 40 GHz are for the 2784 only.

FREQUENCY RELATED

Frequency Range – 100 Hz to 40 GHz in coax, to 325 GHz with external waveguide mixers.

Frequency Readout Accuracy –
$\pm[F(RE + 10^{-10})] + D + M$
F = center frequency.
RE = reference error.
D = 2% of span or 20% of resolution bandwidth, whichever is greater.
M>2 MHz span = (100N) KHz.
M≤2 MHz span = (10N) Hz.
N = L.O. harmonic.

Counter – Range: 100 Hz to 1.2 THz.
Resolution: Selectable from 1 Hz to 1 GHz
$\pm[F(RE + 10^{-10})] + 15N$ Hz + 1 LSD.
Δ Count Accuracy (S/N≥20 dB):
$\pm[\Delta F (RE + 10^{-10})] + 30N$ Hz+ 2 LSD.
F = counter frequency.
RE = reference error.
N = L.O. harmonic.
LSD = least significant digit.

Frequency Reference Accuracy –
Aging <1 x 10^{-6}/year <7 x 10^{-9}/day.
Drift <5 x 10^{-7} over instrument temperature range of –10°C to +40°C.

Frequency Span – Range: 0, 10 Hz to 40 GHz in coax to 600 GHz in external mixer bands. Resolution: ≥100 Hz, selectable in 1% increments. Accuracy: >2 MHz, ±2%, 1 kHz to 2 MHz, ±1%, 100 Hz to 1 kHz, ±7%.

Resolution Bandwidth (6 dB) –
3 Hz to 10 MHz in 1, 3, 10 sequence. Accuracy: 10 MHz, 3 MHz ±20%, 1 MHz to 100 Hz ±15%, 30 Hz, 10 Hz ±20%, 3 Hz +50%, –10% (Typical). Selectivity (–60 dB/–6 dB): <10:1. Shape: Synchronously tuned, six-pole filters.

Video Bandwidth – Range: 0.03 Hz to 7 MHz (Nominal).

Stability – Residual FM: ≤2 MHz span, 1N Hz peak-to-peak over one second; >2 MHz span, 25N kHz peak-to-peak over 500 ms.
Drift (after one hour warm up): ≤2 MHz span 5N kHz/minute of sweep time, >2 MHz span 5N kHz/minute of sweep time (Typical).

Notes: N=L.O. Harmonic. Errors due to drift are not cumulative from sweep to sweep.

2782 and 2784 Resolution Filter Bandwidths –

(Specified) 6 dB	(Typical) 3 dB	(Typical) Random Noise	(Typical) Impulse
3 Hz	2.1 Hz	2.3 Hz	3 Hz
10 Hz	6.9 Hz	7.6 Hz	10 Hz
30 Hz	21 Hz	23 Hz	30 Hz
100 Hz	69 Hz	76 Hz	100 Hz
300 Hz	206 Hz	227 Hz	300 Hz
1000 Hz	686 Hz	758 Hz	1 kHz
3 kHz	2.1 kHz	2.3 kHz	3 kHz
10 kHz	6.9 kHz	7.6 kHz	9 kHz
30 kHz	21 kHz	23 kHz	30 kHz
100 kHz	69 kHz	76 kHz	100 kHz
300 kHz	206 kHz	227 kHz	270 kHz
1 MHz	686 kHz	758 kHz	720 kHz
3 MHz	2.1 MHz	2.3 MHz	2.5 MHz
10 MHz	6.9 MHz	7.6 MHz	4.5 MHz

Spectral Purity –

Noise Sidebands dBc/Hz — Center Frequency

Freq. Offset	Spec. 6.5 GHz	Spec. 12 GHz	Typical 21 GHz	Typical 33 GHz	Typical 40 GHz
100 Hz	–85	–80	–75	–70	–65
1 kHz	–97	–95	–90	–86	–81
10 kHz	–105	–105	–105	–97	–94
100 kHz	–105	–105	–105	–97	–94
1 MHz	–112	–112	–112	–102	–99

AMPLITUDE RELATED:

Maximum Amplitude Range – –135 dBm to +30 dBm.

Displayed Average Noise Level (10 Hz RBW, 0 dB attn.) –

Frequency	Level
100 Hz to 50 kHz	–78 dBm
50 kHz to 10 MHz	–105 dBm
10 MHz to 2.5 GHz	–135 dBm
2.5 GHz to 6.5 GHz	–132 dBm
6.5 GHz to 21.25 GHz	–125 dBm
21.25 GHz to 28 GHz	–120 dBm
28 GHz to 40 GHz	–107 dBm

Using WM782 Waveguide Mixer Series (10 Hz RBW) –

Band	Frequency	Harmonic No.	Level
A	26.5 to 40 GHz	2/4	–135 dBm
Q	33 to 50 GHZ	4	– 135 dBm
U	40 to 60 GHz	4	– 135 dBm
V	50 to 75 GHz	6	–130 dBm
E	60 to 90 GHz	6	–125 dBm
W	75 to 110 GHz	8	–125 dBm
Typical with 100 Hz RBW			
F	90 to 140 GHz	8	–105 dBm
D	110 to 170 GHz	10	–100 dBm
G	140 to 220 GHz	14	–95 dBm
J	220 to 325 GHz	20	–85 dBm

Display Range – log amplifier, 100 dB.
Display Law Range:
Log; 1 dB/div to 15 dB/div.
Linear; 5 nV/div to 22 V/div.
Square Law; 2 aW/div to 100 W/div.
Reference Level Range: –140 dBm to +30 dBm.
Resolution, 0.1 dB.
Accuracy, Log (measurements marker), 0.2 dB/1 dB incremental, ±1.5 dB cumulative over 90 dB range, +2/ –3.5 dB cumulative over 100 dB range at self correcting temp.
Accuracy, Lin, ±5%.
Accuracy, Square Law, ±8%.

Frequency Response (≥10 dB RF attenuation) – 20° to 30°C.

Frequency Range	Variation
100 Hz to 6.5 GHz	±1.0 dB
6.5 GHz to 28 GHz	±4.0 dB
28 GHz to 33 GHz	±4.5 dB
33 GHz to 40 GHz	±5.0 dB

(Attenuator accuracy over frequency included in frequency response.)

Attenuator – Range: 0 to 70 dB, 10 dB steps
Accuracy @ 100 MHz: ±0.5 dB.

IF Gain – Range: 0 to 140 dB. Resolution: 0.1 dB. Accuracy: ±1.0 dB, 0 to 50 dB; ±1.5 dB, 0 to 100 dB; at self correction temperature.

Gain Variation Between Resolution Filters – (Measured at –20 dBm reference level, 10 dB RF atten., and after 2 hour warmup at self correction temperature)

Frequency –

10 MHz to 30 Hz	0.5 dB p-p
10 MHz to 10 Hz	0.75 dB p-p
10 MHz to 3 Hz	2.0 dB p-p

Reference Level Calibration Error – ±0.25 dB (Ref. level –20 dBm, with respect to –20 reference in 3 MHz RBW at self correction temperature).

Band Switching Uncertainty – ±1.5 dB referred to 100 MHz reference signal.

Spectrum Analyzers

Premium Performance Microwave Portable with Ruggedized Color Display

SPURIOUS RESPONSES

Spurious Responses – <–80 dBc + 20 Log N except as noted below.
Residual Signals: <–77 dBm, 100 Hz to 10 MHz; Mixer Level: –30 dBm: <–70 dBm at 2 MHz with 10 kHz and wider resolution bandwidth;
<–100 dBm, 10 MHz to 6.5 GHz;
<–92 dBm, 6.5 GHz to 21 GHz;
<–82 dBm, 21 GHz to 28 GHz;
<–80 dBm, 28 GHz to 40 GHz.

Maximum Dynamic Range – Compression-to-Noise: 132 dB (10 MHz to 6.5 GHz); 117 dB (to 28 GHz); 101 dB (to 40 GHz).
Signal-to-Harmonic Distortion: 80 dB (50 MHz to 6.5 GHz); 100 dB (6.5 GHz to 40 GHz).
Signal-to-Intermodulation Distortion: 98 dB (10 MHz to 6.5 GHz); 83 dB (to 28 GHz); 81 dB (to 40 GHz).

1 dB Gain Compression –
100 Hz to 21 GHz: 0 dBm.
21 GHz to 28 GHz: –3 dBm.
28 GHz to 40 GHz: –6 dBm.

Intermodulation Rejection – Second Order Intercept: >+28 dBm, 1 MHz to 6.5 GHz.
Third Order Intercept: With signal separation <150 MHz and >20 kHz.
Mixer Level –30 dBm: >+15 dBm, 1 MHz to 6.5 GHz, (–90 dBc); >+10 dBm, 6.5 GHz to 28 GHz (–80 dBc).

Second Harmonic Distortion – Mixer Level –40 dBm; <–70 dBc, 50 MHz to 6.5 GHz; <–100 dBc (Typical), 6.5 GHz to 40 GHz.

Out of Band Responses for Input Frequencies <35 GHz –

	Center Frequency Range	
	100 Hz to 28 GHz	28 to 40 GHz
Image Response	<–65 dBc	<–65 dBc
Harmonic Conversions	(Typical) <–65 dBc	(Typical) <–55 dBc

SWEEP GENERATOR AND TRIGGERING

Sweep Generator – Sweep Speed Range: 200 s to 2 µs.
Accuracy: ±5%, 50 µs and slower; ±10%, 20 µs and faster.

Triggering – Adjustable trigger level and slope.
Internal: AC coupled; 10 Hz to 1 MHz.
External: DC coupled; 0 Hz to 5 MHz or 0 Hz to 1.5 kHz.
Line: Copy of AC line.

DISPLAY RELATED

Display Type – Liquid Crystal color shutter, 10 x 10 division graticule.

Digital Storage – Maximum Sweep Rate: 10 ms with 10-bit resolution, 2 ms with reduced horizontal resolution.
Vertical Digitizer Uncertainty: ±0.4%.

Non-Volatile Memory – CMOS battery backed-up RAM, memory retention guaranteed to –10°C.
Battery Type: Lithium cells.
Battery Life (Typical): 1.8 years @ 20°C, 1 year @ 50°C (Batteries are not used when instrument is connected to power source).
Waveforms: 20 waveforms with screen read-outs and labels or date/time stamps.
Front-Panel Setups: 20 complete front-panel setups.
Front-Panel Sequences: 20 sequences, 64 key-strokes/sequence.
Macros: 40K of RAM.
Instrument Calibration Data: Separate EEPROM.

Inputs and Outputs:

RF Input – Frequency Range: 100 Hz to 33 GHz (2782), 100 Hz to 40 GHz (2784). Coupling: DC. Connector: Planar crown system connector with K compatible and N-type adapters as standard accessories. Impedance: 50 Ω.

VSWR	Center Frequency Ranges			
RF Atten	100 Hz to 6.5 GHz	6.5 GHz to 28 GHz	28 GHz to 33 GHz	33 GHz to 40 GHz
≥10 dB	<2.0:1	<2.5:1	<3.0:1	<3.5:1

Maximum Safe Input Power – AC Average Power: +30 dBm with ≥10 dB attenuation.
Pulse Power: 50 Watts peak, 1 µs and <0.005 duty factor with ≥50 dB attenuation.
DC: 0 volts, <100 mA.

Local Oscillator Emission (at 0 dB RF attenuation) **–** ≤–75 dBm, 100 Hz to 6.5 GHz; ≤–65 dBm, 6.5 GHz to 40 GHz.

External Mixer Input (diplexer built-in) **–** Impedance: 50 Ω; VSWR <1.9:1 at 525 MHz and <2.2:1 at 3.525 GHz (Typical).
LO Output Power: ≥15 dBm at 8.1 to 17.9 GHz.

LO Output – Provides access to output of 1st LO at +4 dBm (Typical).

Reference Signal Out – Amplitude: –20 dBm.
Amplitude Accuracy: ±0.3 dB.
Frequency: 100 MHz (derived from reference oscillator).

Ref In/Out – Impedance: 50 Ω nominal.
Input Frequency: 10 MHz ±5 Hz.
Input Signal Amplitude Range: 0 dBm minimum to +15 dBm maximum.
Output Signal (when selected): Nominally 0 dBm at 10 MHz.
Allowable Phase Noise: ≤–100 dBc/Hz at 1 Hz offset (without degrading instrument phase noise performance).

Ext Trig/Horiz – External Trigger input, or external sweep input.

Accessory Connector – 15-pin connector for external inputs and outputs.
Ext. in Display Blanking: Provides external access to CRT beam blanking.
Ext. In Display Horiz and Vert: Provides external access to real-time channel of the instrument; DC coupled; Vert –5 MHz bandwidth (Typical).
Sweep Output: Provides copy of analog sweep.
Ext. in Video: Provides external access to instrument's video processing system; 7.5 MHz bandwidth (Typical).
Penlift: TTL level output to lift plotter pen.
YIG Coil Tune Voltage and Return: Provides external output of the YTO coil tuning voltage and a return path.

Ext V Out – External display horizontal signal output; jumper selectable between full deflection amplifier signal or the real-time signal.

Ext H Out – External display horizontal signal output; jumper selectable between full deflection amplifier signal or the real-time signal.

Ext Z Out – External display blanking signal output.

IF Output – Frequency: 25 MHz (3 MHz and 10 MHz resolution bandwidth).
Amplitude: 3 dBm nominal (–30 dBm reference level, 0 dB RF attenuation, –30 dBm RF input).
Frequency: 4 MHz (1 MHz or less resolution bandwidth).
Amplitude: +9 dBm nominal (–30 dBm reference level, 0 dB attenuation, –30 dBm RF input).
Impedance: Nominal 50 Ω.
VSWR: ≤1.5:1 (Typical).

EXTERNAL INTERFACE PORTS

Two GPIB ports (IEEE Std. 488-1978) are standard.

GPIB Interface – Port 1: SH1, AH1, T5, L3, SR1. Functions: RLO/RL1, PPO, DC1, DT1,CO.
Port 2: SH1, AH1, T5, L3, SRO, RLO, PPO, DCO, DTO, C1, C2, C3, C27, (CO selectable).

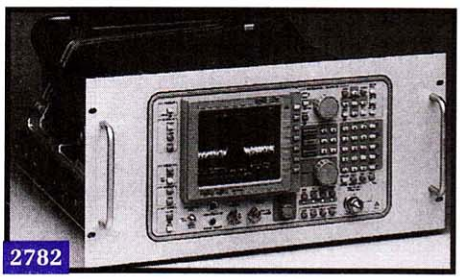
Probe Power – Provides operating voltage for active probes; output voltages are:
pin 1: +5V ±5% @ 100 mA max
pin 2: ground
pin 3: –15V ±5% @100 mA max
pin 4: +15V ±5% @ 100 mA max

Power Requirements –
Input Voltage: 90 to 132 VAC, 47 to 440 Hz, 180 to 250 VAC, 47 to 63 Hz.
Power: At 115 VAC, 60 Hz, 250 W maximum, 2.8 A. Standby Power: 25 W maximum.
Leakage Current: 3.5 mA maximum.

Continued on next page.

Spectrum Analyzers

Premium Performance Microwave Portable with Ruggedized Color Display



Convenient rackmounting with the rack adapter or Option 30.

ENVIRONMENTAL CHARACTERISTICS
(Per MIL-T-28800C, Type III, Class 3, Style C)

Temperature – Operating: –10°C to +55°C. Non-Operating: –62°C to +85°C.

Humidity – 5 cycles per MIL-STD 810D Procedure III (modified).

Altitude – Operating: 15,000 ft. Non-Operating: 40,000 ft.

Vibration – Operating: Tested to MIL-STD 810D Procedure I (modified); resonant search in all axes from 5 to 15 Hz with displacements up to 0.060 inches, 15 to 25 Hz with displacements up to 0.040 inches, and 25 to 55 Hz with displacements up to 0.020 inches.

Shock – Operating and Non-Operating: Tested to withstand three shocks of 30 g, one-half sine, 11 ms duration each direction along each major axis.

Transit Drop – Tested to withstand eight-inch drops, one per each of six faces and eight corners.

ELECTROMAGNETIC INTERFERENCE
MIL-STD 461C Part 4 –
Conducted Emissions: CE01 – 60 Hz to 15 kHz, 15 dB relaxation below 2 kHz; CE03 – 15 kHz to 50 MHz power leads; narrowband and broadband full limits (Navy).

Conducted Susceptibility: CS01 – 30 Hz to 50 kHz power leads, full limits; CS02 – 50 kHz to 400 MHz power leads, 10 dB relaxation at the IF frequencies; CS06 – Spike power leads, full limits.

Radiated Emissions: RE01 – 30 Hz to 50 kHz magnetic field, 5 dB relaxation below 1 kHz and 10 dB relaxation from 1 kHz to 50 kHz; RE02 – 14 kHz to 1 GHz; meets MIL-STD 461C Part 7 to full limits.

Radiated Susceptibility: RS01 – 30 Hz to 50 kHz magnetic field, full limits; RS02 – magnetic induction, 30 dB relaxation at 60 Hz; 20 dB @ 440 Hz; RS03 – limited to 1 V/m from 14 kHz to 1 GHz, with 20 dB relaxation at IF frequencies.

VDE – Meets VDE 0871 Class 1B – Regulations for RFI Suppression of High Frequency Apparatus and Installations.

FCC – Meets FCC Part 15 Subpart J Class A – EMI Compatibility.

German RöV – Meets German RöV, X-Ray Decree, Section 5, March 1973.

PHYSICAL CHARACTERISTICS
Weight – 44 pounds (20 kg); with standard accessories, cover, and no manuals.

Dimensions – 8.05 x 12.90 x 18.59 inches (without front cover, handle, or feet) (204.47 x 327.66 x 472.19 mm);
8.05 x 15.75 x 21.64 inches (with front cover, handle folded back, and feet) (213.36 x 400.05 x 549.11 mm);
8.05 x 15.75 x 24.75 inches (with front cover, handle fully extended, and feet) (204.47 x 400.05 x 624.28 mm).

Safety – Meets the following industry safety standards:
CSA Standard C22.2 No. 231 – Electrical and Electronic Measurement and Testing Equipment.
ANSI/ISA S82 – Safety Requirements for Electronic Measuring and Controlling Instrumentation.
IEC 348, 2nd Edition – Safety Requirements for Electronic Measuring Apparatus.
FM – Electrical Utilization Standard Class 3810.
UL 1244, 2nd Edition – Electrical and Electronic Measuring and Testing Equipment.

Spectrum Analyzers

Premium Performance Microwave Portable with Ruggedized Color Display

2782
2784

ORDERING INFORMATION

2784
Microwave Spectrum Analyzer **$71,500**

2782
Microwave Spectrum Analyzer **$63,500**
Includes: N-male to BNC-female adapter (103-0045-00); N to Planar Crown adapter (131-4329-00); Cable, 50 Ω SMA (012-0649-00); Line fuses: 4 A, 125 VAC (159-0319-00); 4 A, 250 VAC (159-0320-00); Power cord (161-0104-00). Operator's Manual (070-8240-00); Operator's Reference Guide (070-8249-00); Programmer's Manual (070-8241-00); Programmer's Reference Guide (070-8242-00); Installation & Performance Verification Manual (070-8067-00).

Opt. B1 – Two Service Manuals prepared to the component-level ..... **+$250**
Opt. B2 – Complete set of manuals, including Service Manual ..... **+$350**
Opt. 04 – IF output tailored for 3052 ..... **+$2,500**
Opt. 16 – 49X/275X/279X Series GPIB Language ..... **NC**
Opt. 18 – WM782 Bands Q, U, V, E, and W (frequency coverage from 33-110 GHz) ..... **+$14,125**
Opt. 19 – WM782 Bands A, U, E, F, G, and J (frequency coverage from 26-325 GHz) ..... **+$22,870**
Opt. 20 – Utility Software for PC, includes GPIB card ..... **+$1,530**
Opt. 30 – Rackmount adapter (19 in) ..... **+$750**

INTERNATIONAL POWER PLUG OPTIONS
Opt. A1 – Universal Euro 220 V, 50 Hz ..... **NC**
Opt. A2 – United Kingdom 240 V, 50 Hz ..... **NC**
Opt. A3 – Australian 240 V, 50 Hz ..... **NC**
Opt. A4 – North American 240 V, 60 Hz ..... **NC**
Opt. A5 – Switzerland 220 V, 50 Hz ..... **NC**
See Customer Information Section for additional description.

WARRANTY-PLUS SERVICE OPTIONS
Opt. M7 – Calibration Service
2784 ..... **+$1,980**
2782 ..... **+$1,835**
Opt. M9 – Repair Protections
2784 ..... **+$1,560**
2782 ..... **+$1,440**

SOFTWARE
See page 209 for complete description.
2782/2784 PC Utility – Order S26UT00 ..... **$1,400**

CAMERAS/PLOTTERS
See Camera Section page 408 for complete description.
Camera – Low cost. Order C-9 Opt. 1A & Opt. 20 ..... **$710**
Plotter – Four color. Order HC100 Opt. 01 ..... **$1,180**

GPIB Cables –
0.5 m. Order 012-1282-00 ..... **$150**
1 m. Order 012-0991-01 ..... **$170**
2 m. Order 012-0991-00 ..... **$170**
4 m. Order 012-0991-02 ..... **$260**
Waveguide Mixer Cables – Use with WM782 Waveguide Mixers. Order 012-1346-00 ..... **$45**

GPIB CARDS
PC-GPIB Card – IBM PC, AT, and compatibles. Order S3FG210 ..... **$395**
AT-GPIB Card – IBM AT Bus (high speed card). Order S3FG220 ..... **$495**
MC-GPIB Card – IBM PS2 with Microchannel Bus. Order S3FG230 ..... **$495**

ADDITIONAL ACCESSORIES
EMC Ancillary Devices – See page 214.
Rackmount Adapter – Order 016-1019-00 ..... **$825**
Optical to Electrical Converter – Order SA-42 ..... **$3,845**
Service Manual – Module Level. Order 070-8244-00 ..... **$250**
Transit Case – Order 016-0658-00 ..... **$990**
Soft Side Case – Order 016-0659-00 ..... **$155**

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

GPIB IEEE-488 — The 2782, 2784 complies with IEEE Standard 488.1-1987, and with Tektronix Standard Codes and Formats.

Waveguide Mixers

High Performance Waveguide Mixers for 2782 and 2784 Spectrum Analyzers.

WM782 SERIES

- Lowest Conversion Loss Waveguide Mixers Available
- Zero DC Bias
- Improved Reliability
- Increased Sensitivity
- Uniform Size
- Quick Reference Conversion Loss Calibration Chart
- Individually Calibrated
- Rugged LEXAN Plastic Outer Shell
- Anti-Parallel Diodes Reduce Vulnerability to ESD
- Precision Gold-Plated Brass Body
- Odd Harmonic Conversion Products Eliminated

WM782 Series Waveguide Mixers

The Tektronix WM782 Series of Waveguide Mixers are a high-performance, broadband, zero DC bias, anti-parallel dual-diode type mixers for use with the Tektronix 2782 and 2784. The mixer series covers the standard waveguide bands from 26 GHz to 325 GHz.

Each mixer has its own conversion loss chart on the back for easy reference.

The WM782 mixers are of uniform size and shape, and consist of a gold-plated solid brass core with a tough protective outer shell of LEXAN plastic.

Characteristics

Tektronix Model No.	Band Desig.	Freq. Range (GHz)	Sensitivity*1 (dBm)	Freq. Response*2 (dB)	Conv. Loss (dB)	1 dB Compression	Low-Pass Cut-Off Freq. *4
WM782A	A	26 to 40	–115	–	20	0 dBm	16 GHz
WM782Q	Q	33 to 50	–115	±3	20	0 dBm	20 GHz
WM782U	U	40 to 60	–115	±3	20	0 dBm	20 GHz
WM782V	V	50 to 75	–110	±3	25	0 dBm	28 GHz
WM782E	E	60 to 90	–105	±3*3	35	0 dBm	28 GHz
WM782W	W	75 to 110	–105	±3*3	35	0 dBm	28 GHz
WM782F	F	90 to 140	–95	±3 *3	40	0 dBm	32 GHz
WM782D	D	110 to 170	–90	±3 *3	45	0 dBm	40 GHz
WM782G	G	140 to 220	–85	±3 *3	60	0 dBm	40 GHz
WM782J	J	220 to 325	–75	±3 *3	70	0 dBm	40 GHz

**1 Equivalent average noise level using 2782 and 2784 Spectrum Analyzer in 1 kHz resolution bandwidth.*
**2 Maximum amplitude variation across each waveguide mixer band using a 2782 and 2784 Spectrum Analyzer.*
**3 Over any 5 GHz bandwidth for millimeter wave mixers above 60 GHz.*
**4 Low-pass filters in LO/IF path.*

APPLICATIONS

- Spectrum Analysis for Millimeter Wave Frequencies
- Swept Frequency Response Measurements
- Power Level Measurements for Millimeter Wave Frequencies
- For Independent Users, Ideally Suited for Frequency Down Conversion
- Harmonic Generator/Frequency Up Conversion

Tektronix Product	Waveguide (EIA)	(JAN)	Dimensions Flange LxWxH (cm)	Weight (g)
WM782A	WR-28	UG-599/U	9.525x2.54x4.32	113.4
26 to 40 GHz			3.75x1.00x1.70	4.0
WM782Q	WR-22	UG-383/U-M	8.89x2.54x4.32	113.4
33 to 50 GHz			3.50x1.00x1.70	4.0
WM782U	WR-19	UG-383/U-M	8.89x2.54x4.32	113.4
40 to 60 GHz			3.50x1.00x1.70	4.0
WM782V	WR-15	UG-385/U	8.89x2.54x4.32	113.4
50 to 75 GHz			3.50x1.00x1.70	4.0
WM782E	WR-12	UG-387/U	8.89x2.54x4.32	113.4
60 to 90 GHz			3.50x1.00x1.70	4.0
WM782W	WR-10	UG-387/U-M	8.89x2.54x4.32	113.4
75 to 110 GHz			3.50x1.00x1.70	4.0
WM782F *1	WR-08	UG-387/U-M	8.89x2.54x4.32	113.4
90 to 140 GHz			3.50x1.00x1.70	4.0
WM782D *1	WR-06	UG-387/U-M	8.89x2.54x4.32	113.4
110 to 170 GHz			3.50x1.00x1.70	4.0
WM782G *1	WR-05	UG-387/U-M	8.89x2.54x4.32	113.4
140 to 220 GHz			3.50x1.00x1.70	4.0
WM782J 220 to 325 GHz	WR-03			

**1 All mixers are equipped with Standard UG-xxx/U-type flanges. MIL-F-3022-type flanges are available in F, D, and G bands.*

ORDERING INFORMATION

WM782 Waveguide Mixers and Sets

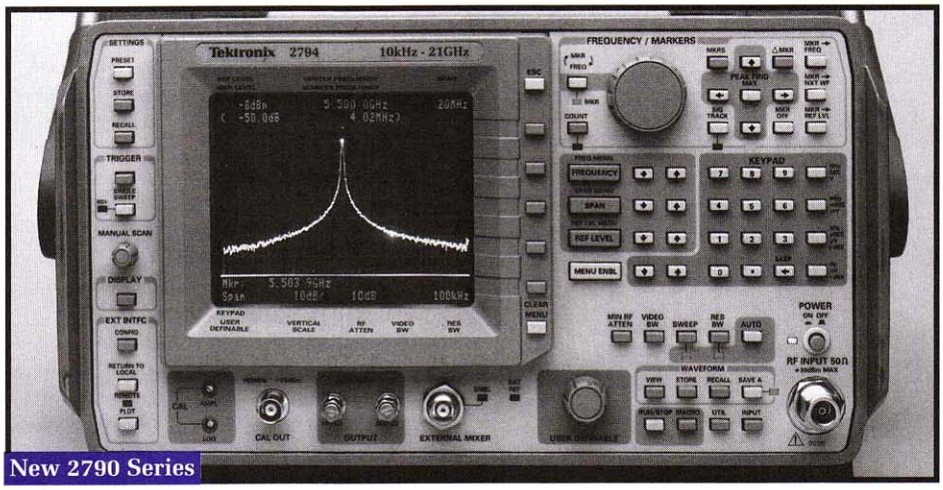
26 to 40 GHz – Order WM782A **$1,963**
33 to 50 GHz – Order WM782Q **$2,285**
40 to 60 GHz – Order WM782U **$2,710**
50 to 75 GHz – Order WM782V **$3,075**
60 to 90 GHz – Order WM782E **$3,340**
75 to 110 GHz – Order WM782W **$3,425**
90 to 140 GHz – Order WM782F **$3,670**
110 to 170 GHz – Order WM782D **$5,114**
140 to 220 GHz – Order WM782G **$5,240**
220 to 325 GHz – Order WM782J **$6,755**
26 to 60 GHz Set – Includes WM782A and WM780U. Order WM7826 ..... **$4,450**
26 to 90 GHz Set – Includes WM7826 plus WM782E. Order WM7827 ..... **$7,630**
26 to 140 GHz Set – Includes WM7827 plus WM782F. Order WM7828 ..... **$11,125**
26 to 220 GHz Set – Includes WM7828 plus WM782G. Order WM7829 ..... **$16,110**
33 to 75 GHz Set – Includes WM782Q and WM782V. Order WM78210 ..... **$5,100**
33 to 110 GHz Set – Includes WM78210 plus WM782W. Order WM78211 ..... **$8,360**
33 to 170 GHz Set – Includes WM78211 plus WM782D. Order WM78212 ..... **$13,230**
Cable – Required for use. Order 012-1346-00 ..... **$95**

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

Spectrum Analyzers

Portable, Rugged with Accessible Performance

2794	2797
2792	2795



New 2790 Series

New 2790 Series

The new Tektronix 2790 Series Spectrum Analyzers are proud successors to the venerable Tektronix 490 Series which has proven itself in years of reliable, rugged service around the world. All units provide full IEEE-488 (GPIB) programmability, which means you can change front-panel settings, read data from the CRT display, and send waveforms from internal digital source memory to other GPIB devices. Frequency ranges of the instruments are as follows:

10 kHz to 325 GHz: 2794
10 kHz to 26.5 GHz: 2792
100 Hz to 7.1 GHz: 2797
100 Hz to 1.8 GHz: 2795

Built to rugged MIL-T-28800C environmental specifications, these units can withstand transportation shock and vibration to a remote site. Or they can simply be moved from the engineering lab to the production floor with complete confidence in measurement accuracy.

A wide array of price/performance alternatives are available. If you need 10 Hz resolution for an exacting close-in spectral purity measurement, consider the 2794. For more routine uses, such as microwave transmitter maintenance, the 2792 may be the most cost-effective solution.

A WIDE ARRAY OF INTELLIGENT FEATURES

Downloadable programming (macro) capability lets you execute your frequently-used measurement routines from the Spectrum Analyzer's nonvolatile memory. In addition, these Spectrum Analyzers can store up to 10 complete front-panel measurement parameter setups in nonvolatile memory to save you measurement time. You can also save up to 9 waveform displays, a real benefit when data analysis must be delayed.

Tedious, time-consuming, and often incorrect carrier-to-noise ratio calculations are eliminated; the instrument handles it all with a single keystroke, with automatic noise normalization to 1 Hz and automatic conversion for reference units such as dBm, dBmV, dBV, dBμV, and dB/Hz.

An internal high-stability reference provides marker or center frequency accuracy approaching 10^{-9}/day in the 2794. For added confidence in measurements, a built-in microwave signal counter in the 2794 with 134 dB compression-to-noise dynamic range means you can determine the exact frequency of marked signals only 30 Hz apart – or count the exact delta-frequency between two marked signals – even with greatly differing amplitudes. You also have the flexibility of tying in with a system clock, using the external reference lock capacity.

A permanent record of CRT displays can be obtained at the push of a button, without a controller, using the direct plot capability and a GPIB plotter such as the Tektronix HC100.

Menu-selected dynamic markers automatically update frequency and amplitude data with every sweep. Unprecedented signal processing power results when you use these markers in conjunction with the built-in intelligence. With PULSE Mode, you can mark the peak of a main lobe and peaks of side lobes at the push of a button. The CW Mode locates signals that exhibit CW characteristics and ignores all other signals. The SPUR Mode marks all signals that meet user-defined or automatic threshold criteria. User-definable threshold criteria are available for all signal processing modes.

2794/2792/ 2797/2795

- 100 Hz to 325 GHz Frequency Coverage
- Continuous-Resolution Frequency Tuning
- Up to 90 dB Viewable Dynamic Range
- Built-in Frequency Counters Provide Frequency Determination to within 0.0000001% ($1x10^{-9}$/day ref.)
- Sensitivities to –134 dBm
- Built-in Intelligence for Signal Processing/Marker Functions
- Push Button Occupied-Bandwidth/Noise-Normalization Functions
- Macro Capability with Nonvolatile Memory
- Optional Switch-Selectable 50/75 Ω Impedances
- Nonvolatile Memory for up to Nine Waveforms and Ten Front Panel Settings
- GPIB Programmability with Tektronix Codes and Formats

APPLICATIONS

- Manufacturing ATE
- Avionics
- Broadcasting
- CATV
- Cellular Radio
- Design and Engineering
- Nuclear Physics
- Radio Astronomy
- Satellite Communications
- Terrestrial Microwave
- Two-Way Radio

Accessible performance at your fingertips.

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

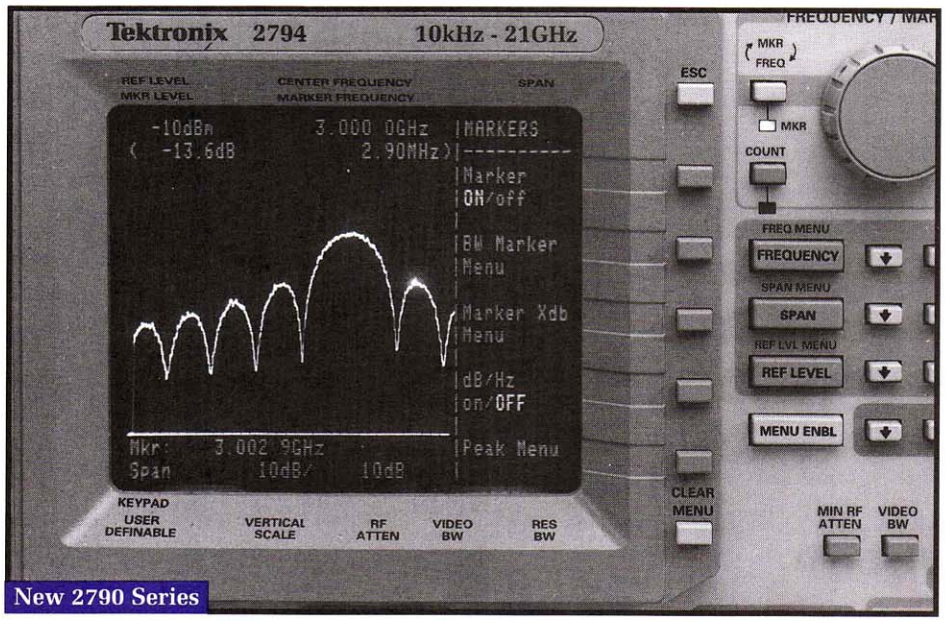
GPIB IEEE-488

The 2790 Series complies with IEEE Standard 488.1-1987, and with Tektronix Standard Codes and Formats.

2794 2797
2792 2795

Spectrum Analyzers

Portable, Rugged with Accessible Performance



New 2790 Series

MENU POWER

The 2790 Series is primarily menu-driven. Pressing one of the four front-panel menu keys brings up a selection menu on the right portion of the display. Each menu selection is assigned to a bezel-mounted selection key; simply press the associated key to make a menu selection. When numeric data is required, it can be entered using the keypad. When menu selection is complete, the menu area is used by the waveform to provide a full-screen display.

Some of the common functions are performed by dedicated function keys or knobs. For example, the FREQUENCY/MARKERS knob provides frequency or marker tuning; the function is shifted between marker or frequency by alternately pressing MKR <–> FREQ.

A unique and powerful feature is the USER DEFINABLE knob which can be assigned to many of the front-panel functions; Span, Reference Level, Resolution Bandwidth, Sweep Speed, Minimum RF Attenuation, plus other functions. This allows you to customize the front panel for measurement convenience.

OPERATOR CONVENIENCE

These instruments also offer operator convenience for measuring the bandwidth of filters, amplifiers, and other networks. Just enter the desired bandwidth point and select BANDWIDTH Mode, and the markers automatically update to display the new value.

Dedicated direct keypad data entry of major measurement parameters enables fast, accurate instrument setup. The unique marker keypad allows Right and Left Next, Next Higher and Lower, Marker to Ref. Level, and Peak Find and Center operations to be executed directly from the front panel. This makes signal searches much easier.

Optional switch-selectable 50 Ω and 75 Ω impedances add versatility. For applications such as baseband and CATV, 75 Ω/dBmV greatly simplifies spectrum analysis.

PRICE/PERFORMANCE SELECTION

The performance leader is the 2794, which offers frequency coverage from 10 kHz to 21 GHz with its internal mixer, and to 325 GHz with external mixers such as the Tektronix WM780 Series (each WM780 Series mixer is individually calibrated). Signal sensitivity is an impressive –134 dBm. The 2794 is optimized for use in baseband through millimeter-wave measurements, where the ability to identify and process signal frequencies and amplitudes over wide dynamic ranges with high accuracy is critical. The 2794 offers full high-resolution and frequency coverage for RF/Microwave component design and test.

The 2792 covers the same coaxial frequency range as the 2794, and provides nearly the same set of outstanding features and state-of-the-art specifications. It is designed as a cost-effective and productive solution to engineering needs. The 2792's frequency range of 10 kHz to 21 GHz is ideal for cost-sensitive applications that still require most of the powerful features of the product family, but can get by with slightly-reduced performance specifications. The 2792 is also ideal for personal communications network testing to 26.5 GHz.

The 2795 features the same functionality and high level of performance as the 2794, but over a frequency range of 100 Hz to 1.8 GHz. It is optimized for stand-alone or automated operation in baseband through UHF measurements, where the ability to identify and process weak signals is critical. The 2795 and TR503 Tracking Generator form a swept frequency system for passive and active component design and test.

The 2797 provides the same cost-effective performance as the 2794, but over a frequency range of 100 Hz to 7.1 GHz. The 2797 is well suited for land, sea, and air mobile communications system design and testing.

REMOTE OPERATION AND COMPLETE SPECTRUM ANALYSIS PACKAGES

Full GPIB-programmability lets you automate your spectrum analysis system needs. Programming is simplified and measurement repeatability ensured. Under program control you can operate the instrument, change front panel settings, read data from the CRT display, and send waveforms from internal memory to other GPIB devices. Tektronix's Standard Codes and Formats keeps commands clear, consistent, and universally understood.

Tektronix spectrum analyzer software lets you use the 2790 Series Spectrum Analyzers as system components, controlling them with popular instrument controllers such as the PC compatibles. Coupling the computer to the Spectrum Analyzer via the IEEE 488 bus lets you take advantage of the PC's capability, as well as the power and versatility of the Spectrum Analyzer.

Tektronix' General RF Applications Software Package (GRASP) offers many different applications and utility routines, which are selected through easy menu-driven operation. Also, EMI software is available for FCC, VDE, CISPR, and MIL-STD testing.

Spectrum Analyzers
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2794 **2797**
2792 **2795**

Characteristics

	2794	2792	2797	2795
Frequency - Related				
Frequency Range with Internal Mixers	10 kHz to 21 GHz	10 kHz to 21 GHz	100 Hz to 7.1 GHz	100 Hz to 1.8 GHz
Frequency Range with External Mixers	10 kHz to 325 GHz	26.5 GHz (Opt. 04)	NA	NA
Frequency Readout Accuracy (center or marker), ±[2% span + (CF x Ref) + (2N + 25) Hz]	±20 kHz @ 1 GHz with 1 MHz span	±30 kHz @ 1 GHz with 1 MHz span	±21 kHz @ 1 GHz with 1 MHz span	±20 kHz @ 1 GHz with 1 MHz span
Frequency Counter Accuracy, ±[(CF x Ref) + (5 + N) Hz + 1 LSD]	±7 Hz @ 1 GHz	±10.013 kHz @ 1 GHz, ±9 Hz @ 1 GHz (Opt. 03)	±1 kHz @ 1 GHz, ±7 Hz @ 1 GHz (Opt. 02)	±7 Hz @ 1 GHz
Delta Count Accuracy, ±[(D-F x Ref) + (10 + 2N) + 1 LSD]	±13 Hz for 1 MHz ΔF	±65 Hz for 1 MHz ΔF	±14 Hz for 1 MHz ΔF	±13 Hz for 1 MHz ΔF
Frequency Reference Accuracy	$\leq 1 \times 10^{-9}$/day (aging)	$\leq 2 \times 10^{-9}$/day (aging) Opt. 03	$\leq 1 \times 10^{-9}$/day (aging) Opt. 02	$\leq 1 \times 10^{-9}$/day (aging)
Frequency Stability (residual FM)	≤3 Hz @ 1 GHz	≤12 Hz @ 1 GHz	≤3 Hz @ 1 GHz	≤3 Hz @ 1 GHz
Frequency Stability (drift)	<50 Hz/minute	<50 Hz/minute	<50 Hz/minute	<50 Hz/minute
Single Sideband Phase Noise (30 kHz offset and N=1)	–105 dBc/Hz @ 1 GHz	–103 dBc/Hz @ 1 GHz	–105 dBc/Hz @ 1 GHz	–105 dBc/Hz @ 1 GHz
Frequency Span Range (plus 0 Hz and MAX)	100 Hz-150 GHz	2 kHz-12 GHz	100 Hz-4 GHz	100 Hz-1.7 GHz
Frequency Span Accuracy	±5%	±5%	±5%	±5%
Delta Frequency Accuracy Marker Mode	1% of span	1% of span	1% of span	1% of span
Resolution Bandwidth (6 dB) Range	10 Hz to 3 MHz	1 kHz to 3 MHz	10 Hz to 3 MHz	10 Hz to 3 MHz
Resolution Bandwidth Selectivity (–60 dB/–6 dB)	≤7.5:1 except 15:1 @ 10 Hz	≤7.5:1	≤7.5:1 except 15:1 @ 10 Hz	≤7.5:1 except 15:1 @ 10 Hz
Video Bandwidth Range	0.3 Hz to 30 kHz	3 Hz to 30 kHz	0.3 Hz to 30 kHz	0.3 Hz to 30 kHz
Amplitude - Related				
Reference Level Range	–117 to +30 dBm	–117 to +30 dBm	–117 to +30 dBm	–117 to +30 dBm
Maximum Safe Input Power, CW	1 Watt (+30 dBm)	1 Watt (+30 dBm)	1 Watt (+30 dBm)	1 Watt (+30 dBm)
Maximum Safe Input Power, Pulse	75 W Pk (1 µS pulse, 0.1% duty factor)	75 W Pk (1 µS pulse, 0.1% duty factor)	75 W Pk (1 µS pulse, 0.1% duty factor)	75 W Pk (1 µS pulse) 0.1% duty factor)
CRT Display Range, Log	1 to 15 dB/div	1 to 15 dB/div	1 to 15 dB/div	1 to 15 dB/div
CRT Display Range, Linear	39.6 nV/div to 2.8 V/div	39.6 nV/div to 2.8 V/div	39.6 nV/div to 2.8 V/div	39.6 nV/div to 2.8 V/div
Input Attenuator Range	0 to 60 dB in 10 dB steps	0 to 60 dB in 10 dB steps	0 to 60 dB in 10 dB steps	0 to 60 dB in 10 dB steps
Dynamic Range (maximums):				
Compression to noise	134 dB	110 dB	130 dB	130 dB
Signal to distortion harmonic	77 dB to 1.7 GHz ≥100 dB 1.7 to 21 GHz	65 dB to 1.7 GHz ≥100 dB 1.7 to 21 GHz	75 dB to 1.7 GHz ≥100 dB 1.7 to 21 GHz	75 dB
Signal to distortion intermod	93 dB to 1.7 GHz ≥100 dB 1.7 to 21 GHz	76 dB to 1.7 GHz ≥100 dB 1.7 to 21 GHz	90 dB to 1.7 GHz ≥100 dB 1.7 to 7.1 GHz	90 dB
Viewable on CRT screen	90 dB	80 dB	90 dB	90 dB
Residual Response (no signal and zero RF attenuation)	–100 dBm (input terminated)	–95 dBm (input terminated)	–100 dBm (input terminated)	–100 dBm (input terminated)
Second Harmonic Distortion, RF Frequency Range	–60 dBc (mixer level –40 dBm)	–60 dBc (mixer level –40 dBm)	–60 dBc (mixer level –40 dBm)	–60 dBc (mixer level –30 dBm)
Second Harmonic Distortion Microwave Frequency Range	–100 dBc (mixer level –20 dBm)	–100 dBc (mixer level –20 dBm)	–100 dBc (mixer level –20 dBm)	NA
Third Order Intermodulation Distortion	–70 dBc (mixer level –27 dBm)	–70 dBc (mixer level –27 dBm)	–70 dBc (mixer level –27 dBm)	–70 dBc (mixer level –27 dBm)
Calibrator Accuracy	±0.3 dB	±0.3 dB	±0.3 dB	±0.3 dB
Gain Compression (1 dB)	0 dBm	0 dBm	0 dBm	0 dBm
Frequency Response (10 dB RF attenuation referred to cal signal):				
Band 1 (10 kHz to 1.8 GHz)	±2.5 dB	±3.0 dB	±2.5 dB	±2.0 dB (100 Hz to 1.8 GHz)
Band 2 (1.7 GHz to 5.5 GHz)	±3.5 dB	±4.0 dB	±3.5 dB	NA
Band 3 (3.0 GHz to 7.1 GHz)	±3.5 dB	±4.0 dB	±3.5 dB	NA
Band 4 (5.4 GHz to 18 GHz)	±4.5 dB	±5.0 dB	NA	NA
Band 5 (15 GHz to 21 GHz)	±6.5 dB	±7.0 dB	NA	NA
In-band Flatness (with 10 dB RF attenuation):				
Band 1 (10 kHz to 1.8 MHz)	±1.5 dB	±2.0 dB	±1.5 dB (100 Hz to 1.8 GHz)	±1.0 dB (100 Hz to 1.8 GHz)
Band 2 (1.7 GHz to 5.5 GHz)	±2.5 dB	±3.0 dB	±2.5 dB	NA
Band 3 (3.0 GHz to 7.1 GHz)	±2.5 dB	±3.0 dB	±2.5 dB (5.4 GHz to 7.1 GHz)	NA
Band 4 (5.4 GHz to 18 GHz)	±3.5 dB	±4.0 dB	NA	NA
Band 5 (15 GHz to 21 GHz)	±5.0 dB	±5.5 dB	NA	NA

Continued on next page.

2794 2797
2792 2795

Spectrum Analyzers

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	2794	2792	2797	2795
Displayed Average Noise Level (input terminated, narrowest resolution bandwidth, and video filter):				
Band 1 (100 Hz)	–80 dBm (typical)	NA	–75 dBm (typical)	–75 dBm (typical)
Band 1 (1 kHz to 10 kHz)	–90 dBm (typical)	–60 dBm (typical)	–95 dBm	–95 dBm
Band 1 (10 kHz to 100 kHz)	–95 dBm	–70 dBm	–115 dBm	–100 dBm
Band 1 (100 kHz to 1 MHz)	–115 dBm	–90 dBm	–120 dBm	–115 dBm
Band 1 (1 MHz to 1.8 GHz)	–134 dBm	–110 dBm	–130 dBm	–131 dBm
Band 2 (1.7 GHz to 5.5 GHz)	–125 dBm	–108 dBm	–127 dBm	NA
Band 3 (3.0 GHz to 7.1 GHz)	–125 dBm	–108 dBm	–126 dBm	NA
Band 4 (5.4 to 12 GHz/12 to 18 GHz)	–111/ –107 dBm	–94 / –89 dBm	NA	NA
Band 5 (15 GHz to 21 GHz)	–106 dBm	–88 dBm	NA	NA
IF Gain Uncertainty	±2 dB max over 107 dB range	±2 dB max over 107 dB range	±2 dB max over 107 dB range	±2 dB max over 107 dB range
Scale Fidelity, Log (80 dB range/90 dB range)	±2 dB max/ ±4 dB max	±2 dB max	±2 dB max/ ±4 dB max	±2 dB max/ ±4 dB max
Scale Fidelity, Linear	±5% of full scale	±5% of full scale	±5% of full scale	±5% of full scale
Input Attenuator Switching Accuracy (20 dB to 60 dB settings):				
0 to 1.8 GHz	±0.5 dB/10 dB; ±1.0 dB max	±0.5 dB/10 dB; ±1.0 dB max	±0.5 dB/10 dB; ±1.0 dB max	±0.5 dB/10 dB; ±1.0 dB max
1.8 to 18 GHz	±1.5 dB/10 dB; ±3.0 dB max	±1.5 dB/10 dB; ±3.0 dB max	±1.5 dB/10 dB; ±3.0 dB max (1.8to 7.1 GHz)	NA
18 to 21 GHz	±3.0 dB/10 dB; ±6.0 dB max	±3.0 dB/10 dB; ±6.0 dB max	NA	NA
Resolution Bandwidth Switching Uncertainty (reference BW = 3 MHz)	±0.4 dB	±0.4 dB	±0.4 dB	±0.4 dB
Time - Related				
Sweep Time Range	200 µsec/div to 100 sec/div	200 µsec/div to 100 sec/div	200 µsec/div to 100 sec/div	200 µsec/div to 100 sec/div
Sweep Time Accuracy	±5%	±5%	±5%	±5%
Marker Time Measurement Accuracy	±10%	±10%	±10%	±10%
Delta Marker Time Measurement Accuracy	±5%	±5%	±5%	±5%
Sweep Trigger	Free Run, Line, Video, Single, Ext	Free Run, Line, Video, Single, Ext	Free Run, Line, Video, Single, Ext	Free Run, Line, Video, Single, Ext
External Input				
RF Input Impedance	50 Ω nominal	50 Ω nominal	50 Ω nominal	50 Ω nominal
VSWR (10 dB input attenuation):				
<2.5 GHz	1.3:1 max	1.3:1 max	1.3:1 max	1.3:1 max
2.5 GHz to 6.0 GHz	1.7:1 max	1.7:1 max	1.7:1 max	NA
6.0 GHz to 18 GHz	2.3:1 max	2.3:1 max	NA	NA
18 GHz to 21 GHz	3.5:1 max	3.5:1 max	NA	NA
Local Oscillator Emission Level (0 dB input attenuation)	≤–70 dBm	≤–70 dBm	≤–70 dBm	≤–70 dBm
External Mixer Input	Approx 2 GHz IF	NA	NA	NA
External Reference Input	1, 2, 5, or 10 MHz	NA	1, 2, 5, or 10 MHz	1, 2, 5, or 10 MHz
Horizontal Input/Trigger Input	0 to +10 V/1 to 50 V	0 to +10 V/1 to 50 V	0 to +10 V/1 to 50 V	0 to +10 V/1 to 50 V
Video Input/Marker Input	0 to +4 V/0 to –10 V	0 to +4 V/0 to –10 V	0 to +4 V/0 to –10 V	0 to +4 V/0 to –10 V
External Output				
Calibrator	100 MHz ±10 Hz, –20 dBm ±0.3 dB	100 MHz ±1 kHz, –20 dBm ±0.3 dB	100 MHz ±100 Hz, –20 dBm ±0.3 dB	100 MHz ±10 Hz, –20 dBm ±0.3 dB
1st Local Oscillator	2 to 6 GHz, +7.5 to +20 dBm	2 to 6 GHz, +7.5 to +20 dBm	2 to 6 GHz, +6 to +20 dBm	2 to 4 GHz, +6 to +20 dBm
2nd Local Oscillator	–12 dBm to +5 dBm	–12 dBm to +5 dBm	–12 dBm to +5 dBm	–10 dBm to +15 dBm
Video Output (CRT center reference)	0.5 V of signal per div of video	0.5 V of signal per div of video	0.5 V of signal per div of video	0.5 V of signal per div of video
Sweep Output (CRT center reference)	0.5 V/div; ±2.5 V max	0.5 V/div; ±2.5 V max	0.5 V/div; ±2.5 V max	0.5 V/div; ±2.5 V max
Pen Lift	+5 V nominal; TTL-compatible	+5 V nominal; TTL-compatible	+5 V nominal; TTL-compatible	+5 V nominal; TTL-compatible

Continued on next page.

Spectrum Analyzers
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2794 2797
2792 2795

External Output (continued)	2794	2792	2797	2795
2nd IF Output (Opt. 42)	110 MHz, 0 dBm; 3 dB BW is 4.5 MHz	110 MHz, 0 dBm; 3 dB BW is 4.5 MHz	110 MHz, 0 dBm; 3 dB BW is 4.5 MHz	110 MHz, 0 dBm; 3 dB BW is 4.5 MHz
3rd IF Output	10 MHz, –5 dBm	10 MHz, –5 dBm	10 MHz, –5 dBm	10 MHz, –5 dBm
Probe Power	+5 V, –15 V, +15 V; 100 mA max each	+5 V, –15 V, +15 V; 100 mA max each	+5 V, –15 V, +15 V; 100 mA max each	+5 V, –15 V, +15 V; 100 mA max each
General Specifications				
Power Requirements:				
Voltage	90-132/180-250 VAC	90-132/180-250 VAC	90-132/180-250 VAC	90-132/180-250 VAC
Frequency	47-63 Hz	47-63 Hz	47-63 Hz	47-63 Hz
Power	210 W max @ 115 VAC, 60 Hz	210 W max @ 115 VAC, 60 Hz	210 W max @ 115 VAC, 60 Hz	210 W max @ 115 VAC, 60 Hz
Weight (carrying), Nominal	22.2 kg (48 lbs)	21.3 kg (46 lbs)	20.83 kg (45 lbs)	19.44 kg (42 lbs)
Dimensions (without handle, feet, or cover), mm/inches	175 x 327 x 499/ 6.9 x 12.87 x 19.65	175 x 327 x 499/ 6.9 x 12.87 x 19.65	175 x 327 x 499/ 6.9 x 12.87 x 19.65	175 x 327 x 499/ 6.9 x 12.87 x 19.65
Digital Storage	1000 pts horizontal, 250 pts vertical	1000 pts horizontal, 250 pts vertical	1000 pts horizontal, 250 pts vertical	1000 pts horizontal, 250 pts vertical
Digitizing Rate	9 µS	9 µS	9 µS	9 µS
Macro Programming	8K	8K	8K	8K
Nonvolatile Memory	9 waveforms, 10 control settings	9 waveforms, 10 control settings	9 waveforms, 10 control settings	9 waveforms, 10 control settings
Environmental (Per Mil-T-28800C, Type III,Class 3, Style C)				
Electromagnetic Compatibility (consult data sheet for compliance details)	MIL-STD-461B	MIL-STD-461B	MIL-STD-461B	MIL-STD-461B
Calibration Interval	1 Year	1 Year	1 Year	1 Year
IEEE 488 (GPIB)				
Interface Functions	SH1, AH1, T5, L3, SR1, RL1, PP1, DC1, DT1, and C0	SH1, AH1, T5, L3, SR1, RL1, PP1, DC1, DT1, and C0	SH1, AH1, T5, L3, SR1, RL1, PP1, DC1, DT1, and C0	SH1, AH1, T5, L3, SR1, RL1, PP1, DC1, DT1, and C0
Direct Plotter Output	Supports Tek HC100, HP7470A	Supports Tek HC100, HP7470A	Supports Tek HC100, HP7470A	Supports Tek HC100, HP7470A
Waveform Transfer Speed	165 msec/1000 pts	165 msec/1000 pts	165 msec/1000 pts	165 msec/1000 pts

ORDERING INFORMATION

2794
Programmable Spectrum Analyzer **$32,450**
Includes: Operator's Manual; Programmer's Manual; 6-ft, 50 Ω coaxial cable, N-N (012-0114-00); 18-inch, 50 Ω coaxial cable, BNC-BNC (012-0076-00); N male to BNC female adapter (103-0045-00); rear connector shield (337-3274-00); power cord and spare fuses; CRT filter set consisting of amber and gray light filters plus mesh filter.

2792
Programmable Spectrum Analyzer **$22,000**
Includes: same as 2794 except gray CRT filter (no filter set).

2797
Programmable Spectrum Analyzer **$26,500**
Includes: Same as 2794.

2795
Programmable Spectrum Analyzer **$22,900**
Includes: Same as 2794.

Opt. 02 – (2797) Precision Frequency Reference. 1 x 10^{-7}/yr aging ..... **+$2,200**

Opt. 03 – (2792) Precision Frequency Reference. 5 x 10^{-7}/yr aging ..... **+$1,500**

Opt. 04 – (2792) Frequency range extension to 26.5 GHz..... **+$2,000**

Opt. 07 – 75 Ω dBmV input and calibration in addition to the normal 50 Ω dBm input and calibration. (Not combinable with Opt. 04 and Opts. 10 through 14.) Includes: 42-inch, 75 Ω BNC-BNC coax cable (012-0074-00) and BNC male to "F" female adapter (013-0126-00) ..... **+$750**

Opt. 10 – (2794) Frequency range extension to 26.5 GHz..... **+$2,000**

Opt. 11 – (2794) Frequency range extension to 40 GHz..... **+$3,500**

Opt. 12 – (2794) Frequency range extension to 60 GHz..... **+$5,500**

Opt. 13 – (2794) Frequency range extension to 140 GHz.... **+$10,500**

Opt. 14 – (2794) Frequency range extension to 325 GHz.... **+$14,500**

Opt. 23 – GRASP software (S26RF00), PC2A interface, GPIB cable..... **+$1,530**
NOTE: The PC2A is a National Instruments GPIB Interface Card.

Opt. 30 – Rackmount with handles for 19 in. rack ..... **+$525**

Opt. 39 – Non-lithium (Silver) batteries for battery-backed memory ..... **+$50**

Opt. 41 – (2792 and 2794) Digital Microwave Radio Measurement Enhancement Package..... **+$450**

Opt. 42 – Replaces MARKER/VIDEO input port on the rear panel with a 110 MHz IF output port that provides a 3 dB signal bandwidth ≥4.5 MHz ..... **+$750**

INTERNATIONAL POWER PLUG OPTIONS

Opt. A1 – Universal Euro 220 V, 50 Hz..... **NC**

Opt. A2 – United Kingdom 240 V, 50 Hz ..... **NC**

Opt. A3 – Australian 240 V, 50 Hz..... **NC**

Opt. A4 – North American 240 V, 60 Hz..... **NC**

Opt. A5 – Switzerland 220 V, 50 Hz..... **NC**

See Customer Information Section for additional description.

Continued on next page.

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

GPIB IEEE-488 — The 2790 Series complies with IEEE Standard 488.1-1987, and with Tektronix Standard Codes and Formats.

2794 2797
2792 2795

Spectrum Analyzers

Portable, Rugged with Accessible Performance

ORDERING INFORMATION

WARRANTY-PLUS SERVICE OPTIONS
Contact your local Tektronix sales office for available warranty options.

SOFTWARE
See pages 209, 210 and 212 for complete description.

GRASP (General RF Applications) Software –
Order S26RF00 ..... **$875**

RSM (Host Site) Software – Order S26RM00 ..... **$300**

RSM (Remote Site) Software – Order S26RM01 ..... **$750**

EMI Prequalification Software – Order S26EM00 ..... **$1,475**

PLOTTER

Plotter – Four color. Order HC01 Opt. 01 ..... **$1,680**

PROBES
See page 423 for complete selection.

FET Probe P6201 – DC to 900 MHz. Order P6201 ..... **$1,495**

FET Probe P6202A – DC to 500 MHz. Order P6202A **$995**

50 Ω Divider Probe P6156 – DC to 3.5 GHz, 6 ft.
Order P6156 ..... **$255**

Current Probe P6022 – 935 Hz to 120 MHz. Order P6022 ..... **$585**

POWER SPLITTER
75 Ω/50 Ω BNC Output, 50 Ω BNC Input.
Order 067-1232-00 ..... **$275**

CABLES, PADS AND ADAPTERS

50 Ω Coaxial Cable –
BNC to BNC 5.5 in. Order 012-0214-00 ..... **$60**
BNC to BNC 18 in. Order 012-0076-00 ..... **$31**
BNC to BNC 42 in. Order 012-0057-01 ..... **$28**

75 Ω Coaxial Cable –
BNC to BNC 42 in. Order 012-0074-00 ..... **$31**

GPIB Cables –
0.5 m. Order 012-1282-00 ..... **$150**
1 m. Order 012-0991-01 ..... **$170**
2 m. Order 012-0991-00 ..... **$170**
4 m. Order 012-0991-02 ..... **$260**

CARTS – K218 Instrument Cart **$695**

75 Ω to 50 Ω Minimum Loss Attenuator – With DC block, 5.7 dB loss. Order 011-0112-00 ..... **$85**

75 Ω to 50 Ω Matching Attenuator – With 11.25 dB conversion factor from dBm to dBV with DC block. Order 011-0118-00 ..... **$95**

"F" Female to BNC Male Adapter – Order 013-0126-00 ..... **$22**

BNC Female to "F" Male Adapter – Order 103-0158-00 ..... **$14**

"N" Female to BNC Male Adapter – Order 103-0058-00 ..... **$15.50**

BNC Female 75 Ω to N Male 50 Ω Adapter –
Order 103-0273-00 ..... *1

75 Ω to 50 Ω Matching Transformer – 0.5 dB loss.
50 kHz to 300 MHz. Order 120-1883-00 ..... **$170**
5 MHz to 1 GHz. Order 120-1884-00 ..... **$170**

DC BLOCKS

N to N – DC Block 015-0509-00 is rated over the coaxial frequency range of 10 kHz to 21 GHz. Its electrical characteristics, rugged construction, and type "N" connectors make it the preferred solution for EMI/RFI and other applications requiring the blocking of 2790 front ends. Characteristics - Operating Frequency: 10 kHz to 21 GHz. Insertion Loss: 1.0 dB maximum. VSWR: 1.4:1 maximum, 10 kHz to 18 GHz; 1.6:1 maximum 18 to 21 GHz. Voltage Rating: 50 VDC maximum. Impedance: 50 Ω Connectors: Type "N" male and female.
Order 015-0509-00 ..... **$430**

BNC to BNC – Maximum DC potential 50 V.
Order 015-0221-00 ..... **$130**

GPIB CARDS

PC-GPIB Card – IBM PC, AT, and compatibles.
Order S3FG210 ..... **$395**

AT-GPIB Card – IBM AT Bus (high speed card).
Order S3FG220 ..... **$495**

MC-GPIB Card – IBM PS2 with Microchannel Bus.
Order S3FG230 ..... **$495**

ADDITIONAL ACCESSORIES

EMI Ancillary Devices – See page 214.

Service Manuals –
2797, Volume I. Order 070-8638-00 ..... *1
2797, Volume II. Order 070-8642-00 ..... *1
2795, Volume I. Order 070-8637-00 ..... *1
2795, Volume II. Order 070-8641-00 ..... *1
2794, Volume I. Order 070-8636-00 ..... *1
2794, Volume II. Order 070-8640-00 ..... *1
2792, Volume I. Order 070-8635-00 ..... *1
2792, Volume II. Order 070-8639-00 ..... *1

Service Kit – Order 006-3286-01 ..... *1

Diplexer Assembly – For 2790 Series and WM780 Waveguide Mixers. Order 015-0385-00 ..... **1,765**

Diplexer Interconnecting Cable – Required for use with Diplexer Assembly. 50 Ω, SMA-to-SMA. Order 012-0649-00 ..... **$41**

Rack Adapter – 19 in. Order 016-0844-01 ..... **$670**

Rear Panel Connector Cover – Order 337-3274-00 ..... **$5.00**

Soft Side Case – Order 016-0659-00 ..... **$155**

Transit Case – Order 016-0658-00 ..... **$990**

TV Sideband Analyzer Adapter – 525/60 markers.
Order 1405 ..... **$5,980**

Tracking Generator – 100 Hz to 1800 MHz. Order TR503 ..... **$7,080**

Microwave Comb Generator – TM500 Series compatible.
Order 067-0885-00 ..... **$2,265**

*1 *Contact your local Tektronix representative for price information.*

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

GPIB IEEE-488 — The 2790 Series complies with IEEE Standard 488.1-1987, and with Tektronix Standard Codes and Formats.

Waveguide Mixers

WM780 Series Waveguide Mixers

The Tektronix WM780 Series Waveguide Mixers cover a frequency range of 18 to 325 GHz with optimum flatness. Although designed specifically for use with the Tektronix 2790 Series Spectrum Analyzers, they are also compatible with most other spectrum analyzers. They can serve a wide variety of general-purpose uses, such as down-conversion for noise figure and network analysis measurements.

WM780 Series Waveguide Mixers feature individual frequency characterization curves attached to the housing for improved measurement accuracy.

All mixers are gold-plated brass, conforming to MIL-G-45204 Class I, Type 1 specifications, and will withstand harsh environments.

WM780 SERIES

- 18 to 325 GHz Frequency Range
- Frequency Response is ±2 dB (2790 series)
- Precision Gold-Plated Brass Body
- Individual Frequency Characterization Curves Attached to Housing
- Custom Characterization Available

APPLICATION

- Down Conversion
- Network Analysis Measurements

Extended Spectrum Analyzer Measurement Capability from 18 GHz to 325 GHz.

ELECTRICAL CHARACTERISTICS

Tektronix Model No.	Band Desig.	Frequency Range (GHz)	Sensitivity*1 (dBm)	Frequency*2 Response (dB)	Conversion*3 Loss Typical (dB)	Low-Pass*6 Cutoff Frequency
WM780K	K	18-26.5	–100	±2	30	12 GHz
WM780A	A	26.5-40	–95	±2	30	16 GHz
WM780Q	Q	33-50	–90	±2	35	21 GHz
WM780U	U	40-60	–90	±2.5	35	16 GHz
WM780V	V	50-75	–90 @ 50 GHz –85 @ 75 GHz typ	±3 *4 typical	35 @ 50 GHz 40 @ 75 GHz	28 GHz
WM780E	E	60-90	–80 @ 60 GHz –80 @ 90 GHz typ	±3 *4 typical	35 @ 60 GHz 45 @ 90 GHz	28 GHz
WM780W	W	75-110	–80 @ 75 GHz –70 @ 110 GHz typ	±3 *4 typical	45 @ 75 GHz 55 @ 110 GHz	30 GHz
WM780F	F	90-140	–75 @ 90 GHz –65 @ 140 GHz typ	±3 *4 typical	50 @ 90 GHz 60 @ 140 GHz	32 GHz
WM780D	D	110-170	–70 @ 110 GHz –60 @ 170 GHz typ	±3 *4 typical	50 @ 110 GHz 60 @ 170 GHz	40 GHz
WM780G	G	140-220	–65 @ 140 GHz –55 @ 220 GHz typ	±3 *4 typical	55 @ 140 GHz 65 @ 220 GHz	40 GHz
WM780J	J	220-325	–55 @ 220 GHz, *5 –45 @ 325 GHz typ	±3 *4 typical	65 @ 220 GHz 75 @ 325 GHz	40 GHz

**1 Equivalent average noise level (using a 2790 Series Spectrum Analyzer in 1 kHz resolution bandwidth).*

**2 Maximum amplitude variation across each waveguide mixer band (using a 2790 Series Spectrum Analyzer with peaking control optimized at each frequency in response to a –30 dBm CW input signal to the mixer).*

**3 LO drive ±10 dBm peaking control optimized.*

**4 Over any 5 GHz bandwidth for millimeter wave mixers above 60 GHz.*

**5 Value estimated at 325 GHz.*

**6 These low-pass filters are in LO/IF connector.*

ORDERING INFORMATION

WM780 WAVEGUIDE MIXERS AND SETS

18 to 26.5 GHz – Order WM780K **$1,690**
26.5 to 40 GHz – Order WM780A **$1,700**
33 to 50 GHz – Order WM780Q **$1,955**
40 to 60 GHz – Order WM780U **$2,325**
50 to 75 GHz – Order WM780V **$2,635**
60 to 90 GHz – Order WM780E **$2,860**
75 to 110 GHz – Order WM780W **$2,940**
90 to 140 GHz – Order WM780F **$3,140**
110 to 170 GHz – Order WM780D **$4,385**
140 to 220 GHz – Order WM780G **$4,490**
220 to 325 GHz – Order WM780J **$5,675**

18 to 40 GHz Set – Includes WM780K, WM780A. Order WM7802 ..... **$3,150**
18 to 60 GHz Set – Includes WM780K, WM780A, WM780U. Order WM7803 ..... **$5,320**
33 to 170 GHz Set – Includes WM780Q, WM780V, WM780W, WM780D. Order WM78012. ..... **$11,680**

ACCESSORIES

Diplexer Assembly – Required for 2790 Series. Order 015-0385-00 ..... **$320**
Diplexer Interconnecting Cable – Required for 2790 Series. 50 Ω, SMA-to-SMA. Order 012-0649-00 ..... **$41**
Case – Order 016-0465-01 ..... **$30**

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

1405
TR 503

Tracking Generator TV Sideband Adapter

Use with your spectrum analyzer to make scalar analysis and frequency response measurements.

1405

- Facilitates In-Service or out-of-service Testing of Transmitter
- Measure Transmitter Frequency Response to within ±0.2 dB
- Video Circuits Can be Swept
- Check Aural FM Deviation with Built-In Bessel Null Technique
- Flexible Marker System Will Accept Standard Crystals

TR 503

- Swept Measurements to 1.8 GHz
- Enhances Dynamic Range to Better than 110 dB
- Very Stable–Useful as a CW Signal Source
- Auxiliary, Constant Level Output Provides for Frequency Counter Measurement Even of Signals at the Noise Floor

1405

1405/TV Sideband Adapter

The 1405 Sideband Adapter works with 279X, 275X, 271X, and 49X Series Spectrum Analyzers to analyze the sideband response of a television transmitter. It generates a composite video signal, which is applied as modulation to a television transmitter. The output is displayed on the spectrum analyzer and appears as a response curve, typically to within ±0.2 dB, of the transmitter being tested.

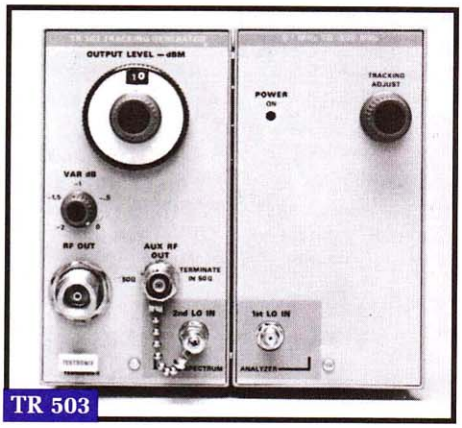
The 1405/Spectrum Analyzer combination display frequency characteristics of RF and IF circuits for transmitters with frequencies to 1 GHz. Video circuits can also be analyzed.

Corrected frequency/channel dials for the 1405 are provided by Option 02 (for use with the 279X Series) and Option 03 (for use with the 271X Family).

Call your local sales engineer for additional information.

TR 503/Tracking Generator

The TR 503 works with all 490, 2750, and 2790 Series spectrum analyzers to provide constant level, calibrated RF sources for swept frequency tests to 1.8 GHz. The tracking generator is a two-wide unit compatible with the TM 500 and TM 5000 Modular Instrument Series.



TR 503

The low residual FM of these systems enhances narrow bandwidth frequency response measurements. When used as a CW signal source with the analyzer in a zero span, these systems have excellent frequency stability.

The tracking generator sweep rates are controlled with the spectrum analyzer, and the output level is controlled from the tracking generator. The output frequency of the tracking generator is the same as the frequency of the analyzer at any instant of the sweep.

Characteristics

TR 503/2790 SERIES

Frequency Range – 100 kHz to 1.8 GHz.

Output Level – (Max) 0 dBm ±0.5 dB.

Range – 0 to 59 dB in 10 dB and 1 dB steps.

Flatness – Within ±2.25 dB Max from 100 kHz to 1.8 GHz (Typically ±1.5 dB).

Dynamic Range – ≥110 dB.

Residual FM – 50 Hz p-p.

Output Impedance – 50 Ω Nominal, VSWR 2:1 or less to 1.8 GHz.

Auxiliary Output – 0.1 V RMS into 50 Ω load. 7 dBm minimum.

ORDERING INFORMATION

1405

TV Sideband Adapter 525/60 Markers **$5,980**

Includes: Instruction Manual (070-2078-00).

Opt. 01 – TV Sideband Adapter (625/50 Markers) ..... **+$200**

Opt. 02 – Dial Readout for 2790 Series Spectrum Analyzers ..... **NC**

Opt. 03 – Dial Readout for 271X Spectrum Analyzer Family ..... **NC**

TR 503

Tracking Generator **$7,080**

Includes: Two 50 Ω coax cables (012-0649-00); N male to BNC female adapter (103-0045-00); Retainer Plug-in (343-0604-00); Instruction Manual (070-3526-00).

ACCESSORIES

Power Module – Order TM 503A **$395**

Power Module – Order TM 504 ..... **$695**

Blank Panel – Order 016-0195-05 ..... **$47**

INTERNATIONAL POWER PLUG OPTIONS

Opt. A1 – Universal Euro 220 V, 50 Hz ..... **NC**

Opt. A2 – United Kingdom 240 V, 50 Hz ..... **NC**

Opt. A3 – Australian 240 V, 50 Hz ..... **NC**

Opt. A4 – North American 240 V, 60 Hz ..... **NC**

Opt. A5 – Switzerland 220 V, 50 Hz ..... **NC**

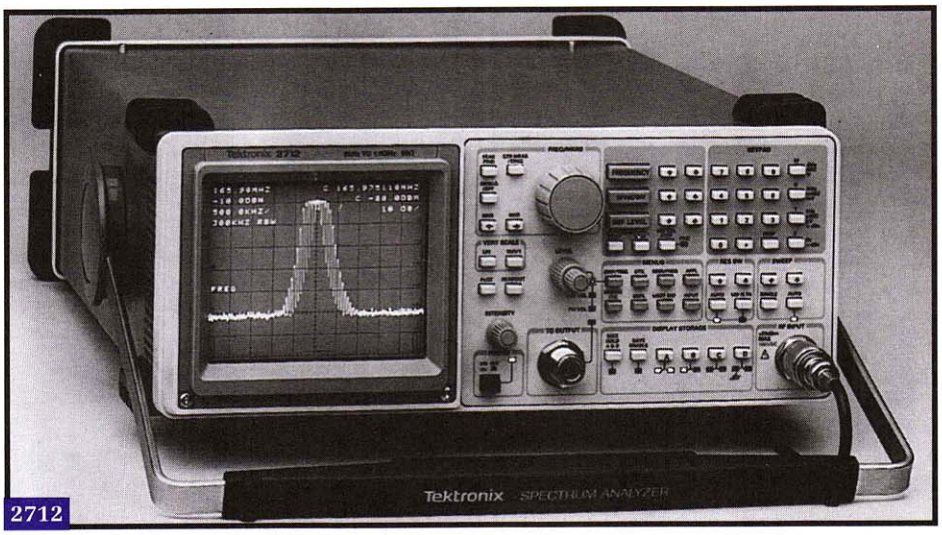
See Customer Information Section for additional description.

Rackmount Conversion Kit – Standard 19-inch Rack. Order 016-0489-00 ..... **$735**

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

Spectrum Analyzers
Versatile, Low-Cost

2712
2711



2712

2712 Spectrum Analyzer

The Tektronix 2712 Spectrum Analyzer provides excellent RF performance, a built-in frequency counter, full programmability, digital and true analog displays, high portability, enough nonvolatile memory for 108 saved displays, and much more.

A straightforward human interface, with conveniently-grouped, dedicated front-panel keys and simple, menu-driven functions makes the 2712 easy to learn and use. You can set frequency, span, and reference level directly from the front panel. A real-time clock provides an on-screen date and time display, plus date/time stamp capability for waveform printouts.

Frequency-corrected tuning and phaselock stabilization enhance the ability to resolve close-in signals and reliably demodulate narrowband signals. Sensitivity up to –127 dBm (–80 dBmV) at 300 Hz resolution bandwidth (RBW) lets you see weak signals. The built-in preamp can improve sensitivity another 12 dB, up to –139 dBm (–92 dBmV). Up to 80 dB on-screen dynamic range ensures visibility of weak signals in the presence of strong ones.

A 300 Hz RBW filter with a shape factor ≤7:1 means you'll see many close-in sidebands and spurious, or unexpected signals you might otherwise miss. At the other end of the spectrum, the 5 MHz RBW filter is useful when demodulating wideband signals such as actively modulated video carriers.

The built-in signal counter, with 0.5 ppm ±10 Hz accuracy, offers added power for rapidly identifying signals. The capability to choose between digital and true analog displays lets you examine signals for characteristics that are not visible on digital-only displays.

Sweep speeds of 1 µsec/div, TV Line and TV Field triggering, an internal audio amplifier and AM/FM detectors, and the optional Video Monitor Mode all make video communications measurements easier.

Bandwidth, Carrier-to-Noise, Noise Power, Signal Search, and FM Deviation modes provide additional measurement power and convenience. Occupied Bandwidth Mode, with percent settable from 1 to 99%, aids in broadcast radio measurements.

The optional internal tracking generator provides high dynamic range swept measurements to 1.8 GHz.

EMC MEASUREMENT

To help simplify your EMC measurements, the 2712 offers an optional quasi-peak detector, EMI resolution bandwidth filters, and fully-corrected E-field intensity measurements to assist in pre-certification and troubleshooting. EMC ancillary devices are available to provide a complete measurement solution. See pages 211 to 214.

SELECTION GUIDE

Capability	2712	2711
Frequency Range	9 kHz to 1.8 GHz	9 kHz to 1.8 GHz
±0.5 ppm Freq. Accuracy	Std	NA
Signal Counter	Std	Opt. 02
GPIB Interface	Std	Opt. 03
Internal Tracking Gen.	Opt. 04	Opt. 04
Inverter/Battery Pack	Opt. 07	Opt. 07
RS-232-C Interface (replaces GPIB)	Opt. 08 (no charge)	Opt. 08
Video Monitor Mode	Opt. 10	Opt. 10
EMC Pre-Certification Measurements	Opt. 12	NA
TV Sideband Adapter Interface	Opt. 15	Opt. 15
Nonvolatile Memory	124K	28K (124K with Opt. 03 or 08)
High Portability	Yes	Yes
Both Digital and True Analog Displays	Yes	Yes
Dedicated Numeric Keypad	Yes	Yes
Real-Time Clock	Std.	With Opt. 03 or 08

2712

- High Value, Low Cost
- 5 x 10^{-7} Frequency Accuracy
- Sensitivity to –139 dBm (–92 dBmV) with Built-in Preamp
- Internal Frequency Counter
- Full Programmability
- Realtime Clock
- 124K of RAM
- Easy to Use
- Dedicated Numeric Keypad Plus Logically Grouped Menu Keys
- Powerful Built-in Measurement Routines
- EMC Measurements with Optional Quasi-Peak Detector
- Swept Measurements to 1.8 GHz with Optional Internal Tracking Generator

2711

- Economical, Can Be Configured to Meet Most Budgets
- High Portability
- Internal Tracking Generator Option
- Video Monitor Mode Option
- GPIB or RS-232 Interface Option
- Excellent Frequency Accuracy and Sensitivity
- 3-Control Operation for Most Measurements

Very lightweight, portable spectrum analyzers – packed with affordable measurement power.

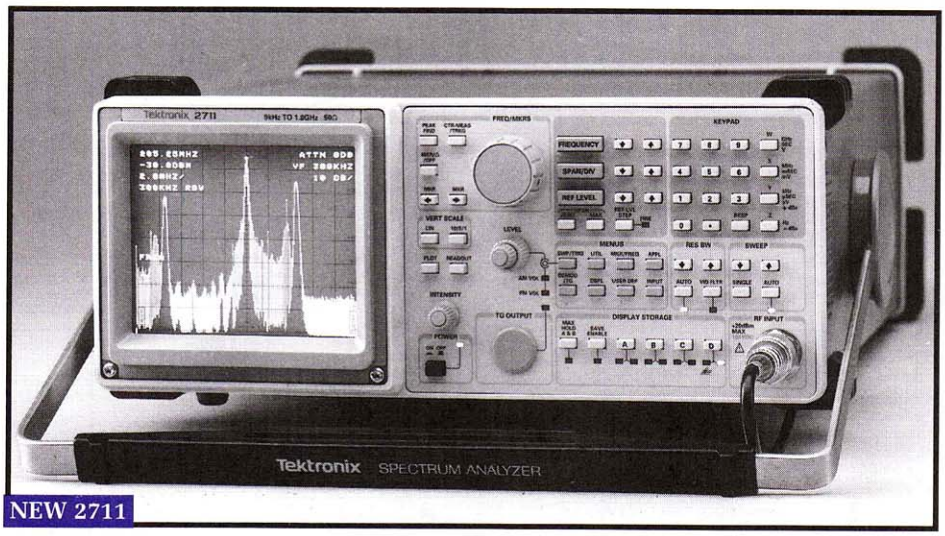
TD
Product also available within 24 hours through TekDirect. Call 1-800-426-2200

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

GPIB IEEE-488
The 2712 and 2711 complies with IEEE Standard 488.1-1987, and with Tektronix Standard Codes and Formats.

2712
2711

Spectrum Analyzers
Versatile, Low-Cost



NEW 2711

New 2711 Spectrum Analyzer

The 2711 offers a wide range of features at an extremely affordable price. This value leader is well-suited for checking broadcast transmitter performance and communications system operations, looking for unwanted RF emissions, testing two-way communications equipment, maintaining industrial security, and teaching frequency domain concepts in the classroom, plus a wide variety of other applications.

The standard 2711 shares many of the 2712's valuable features. Compact size, light weight (9.5 kg, about 21 lbs.), and available battery operation (refer to 2704 Inverter/2705 Battery Pack descriptions) means you can operate in almost any environment. Both instruments can also be quickly converted to rack operation with optional rackmount adapters.

Frequency accuracy is 1 x 10^{-5} and sensitivity is up to –117 dBm (–70 dBmV) at 3 kHz RBW. The built-in preamp can add another 12 dB, up to –129 dBm (–82 dBmV). Up to 80 dB on-screen dynamic range helps see weak signals, even when strong ones are present.

True analog display capability, along with fast sweep speeds and TV Line and TV Field triggering provide convenient demodulation of video carriers for making depth-of-modulation checks or looking at special baseband data, VITS, and many other signals.

An internal audio amplifier and AM/FM detectors let you hear demodulated signals, using either the built-in speaker or headphone jack, for fast signal identification and troubleshooting in communications applications.

With the Video Monitor (Option 10) installed, you can view broadcast (AM) TV signals or down-converted satellite (FM) signals.

The 2711 can also be used with a set of near-field probes as a handy EMC diagnostic tool.

Characteristics

The following characteristics apply to both the 2712 and 2711 after a 15-minute warmup period, unless otherwise noted.

FREQUENCY RELATED

Frequency Range – 9 kHz to 1800 MHz.

Center Frequency Accuracy – 2712: 5x10^{-7} of CF ±700 Hz; 2711: 1x10^{-5} of CF ±5 kHz.

Frequency Counter Accuracy (Std 2712, Opt 02 2711) – 2712: 5x10^{-7} of CF ±10 Hz, ±1 LSB. 2711: 1x10^{-5} of CF ±10 Hz, ±1 LSB.

Dot Marker Frequency Accuracy* – CF Accuracy ±3% of span.

Long-Term Drift* – 2712: 2 ppm/yr.; 2711: 10 ppm/yr.

Short-Term Drift – 2712: ≤400 Hz maximum drift between correction cycles; 2711: ≤20 kHz maximum drift between correction cycles.

Residual FM – 2712: ≤100 Hz p-p/20 msec at ≤20 kHz span/div; ≤2 kHz p-p/20 msec at >20 kHz span/div; 2711: ≤2 kHz p-p/20 msec.

Resolution Bandwidth (–6 dB) – 2712: 5 MHz, 300 kHz, 30 kHz, 3 kHz, 300 Hz; 2711: 5 MHz, 300 kHz, 30 kHz, 3 kHz; 2712 w/Opt. 14: Add 1 MHz, 100 kHz, 10 kHz, and 1 kHz.

Resolution Bandwidth Shape Factor (60 dB/6 dB) – ≤7:1

Noise Sidebands – ≤70 dBc at 30xRBW.

Video Filter – Approx. 1/100 (Auto) of RBW. Manual Selection: 3 Hz to 300 kHz in 1-3 sequence.

Freq. Span/Div Range – 2712: 180 MHz to 1 kHz. 2711: 180 MHz to 10 kHz selected in 1-2-5 sequence or 2 significant digits via menu.

Span Accuracy – ±3% over the center eight divisions.

AMPLITUDE RELATED

Flatness – ±1.5 dB measured with 10 dB internal RF attenuation (preamp off).

Vertical Display Modes – 10, 5, 1 dB/div, Linear.

Measurement Range – 2712: –139 (preamp on) to +20 dBm (–92 to +67 dBmV); 2711: –129 (preamp on) to +20 dBm (–82 to +67 dBmV).

Display Dynamic Range – 80 dB max (limited to 40 dB in optional 2712 Quasi-peak Detector mode).

Reference Level Range – LOG Mode: –70 to +20 dBm (–23 to +67 dBmV), or down to –90 dBm with preamp on. LINEAR Mode: 8.8 µV to 280 mV.

Reference Level Steps – LOG Mode: 1 dB or 10 dB. LINEAR Mode: 1-2-5 sequence.

Mixer Input Level – Automatically controlled by instrument for on-screen signals. Level selectable between –20 to –50 dBm (+27 to –3 dBmV).

Display Amplitude Accuracy – 10 dB/Div: ±1.0 dB/10 dB to max. cum. error of ±2 dB over 70 dB range; ±2.0 dB/10 dB over 70-80 dB range. 5 dB/Div: ±1.0 dB/10 dB to max. cum. error of ±2 dB over 40 dB range; 1 dB/Div: 1 dB max. error over 8 dB range. Linear Mode: ±5% of full scale.

RF Attenuation Range – 0 to 50 dB, 2 dB steps.

Sensitivity – 2712: –127 dBm (–80 dBmV) at 300 Hz RBW, –139 dBm (–92 dBmV) at 300 Hz RBW with preamp on (to 600 MHz); 2711: –117 dBm (–70 dBmV) at 3 kHz RBW, –129 dBm (–82 dBmV) at 3 kHz RBW with preamp on (to 600 MHz).

SPURIOUS RESPONSE (PREAMP OFF)

Residual Spurious Response – ≤–100 dBm referenced to input of 1st mixer.

3rd Order IM Distortion – ≤–70 dBc, from any two on-screen signals within any frequency span measured with 1st mixer input level of ≤–30 dBm (+17 dBmV).

2nd Harmonic Distortion – ≤–66 dBc measured with 1st mixer input level of ≤–40 dBm (+7 dBmV).

INPUT RELATED

LO Emission – ≤–70 dBm with 0 dB RF attenuation.

RF Input – Type N connector, 50 Ω.

VSWR with 10 dB or More RF Attenuation – 1.5:1 max.

Maximum Safe Input – +20 dBm (+67 dBmV) (0.1 W) continuous peak with 0 dB RF attenuation; 100 VDC (initially applied with full attenuation).

1 dB Compression Point – ≥–15 dBm (+32 dBmV) with 0 dB RF attenuation.

** Typical but nonwarranted performance parameters.*

Spectrum Analyzers
Versatile, Low-Cost

2712
2711

SWEEP RELATED

Sweep Times – 1 µsec to 2 sec/div in 1-2-5 seq. (7-decade range); AUTO SWEEP mode; MANUAL SWEEP select.

Sweep Time Accuracy – ±10% over the center eight divisions.

Trigger – Free run, internal, external, line, TV field, TV line, single sweep, manual scan.

Trigger Amplitude – Internal: One division or more of signal. External: min. 1.0 V peak, (15 Hz to 1 MHz).

INPUT/OUTPUT CHARACTERISTICS

External Trigger* – BNC connector, 10 kΩ impedance, DC coupled 0.1 µs min. pulse width. 35 V max.

External Video Input* – DC coupled. 0-50 kHz, 0-1.4 V (175 mV/div typical) signal input for vertical deflection of CRT beam.

Sweep Gate Out – TTL level, HI while CRT beam sweeps.

Sweep Output – +1.3 to –1.3 V, negative-going ramp, proportional to the horizontal sweep. Source impedance ≤50 Ω.

Video Output – 0 to +1.6 V of video signal, proportional to vertical display amplitude. 0 V is top of screen. 1 kΩ impedance.

ENVIRONMENTAL SPECIFICATIONS

Temperature – Operating: 0° to 50°C (MIL-T- 28800D). Nonoperating: –55° to +75°C.

Humidity – Nonoperating: Five cycles (120 hours) per MIL-T-28800D, Class 5.

Vibration – Meets MIL-T-28800D Method 514 Procedure X (modified).

Shock – Operating and Nonoperating: Three guillotine-type shocks of 30 g, one-half sine, 11 ms duration each direction along each major axis; total of eighteen shocks.

Radiated and Conducted Emissions – Meets FCC Part 15, Sub-part J, Class A and VDE 0871, Class B.

GENERAL CHARACTERISTICS

Power Requirements – 90 W max. (1.2 A) at 115 V, 60 Hz. Operates 48 Hz to 440 Hz, 90 to 132 VAC, or 48 Hz to 63 Hz to 250 VAC. Battery power (Opt. 07) available.

Weight – 9.5 kg (<21 lb.) nominal for basic configuration.

Dimensions (H,W,D) with Feet, Handle, and Front Panel Cover – 137 x 361 x 445 mm (5.4 x 14.2 x 17.5 in.).

OTHER CAPABILITIES

Markers – Single marker/delta marker; next right, next left peaks; next lower, next higher peaks; (highest) peak find; marker to center frequency and reference level.

Nonvolatile Memory – Lithium battery backup. 2712: 124 kBytes available; up to 108 displays saved; 36 front-panel setups, large user- definable key routines, and antenna tables (exact number and size depends on NV RAM utilization). 2711: 28 kBytes available; Up to 18** displays saved and 9** front-panel setups, user-definable key routines, and antenna tables.

Digital Storage Display – Selectable acquisition modes of positive peak only, positive/negative peak. SAVE A, B, C and active D trace; up to 4 traces on screen; MAX HOLD A, B; MIN HOLD A, B, C; B, C MINUS A; WATERFALL display mode; digital storage off provides analog sweep.

Ensemble Averaging – Provides weighted continuous or discrete averaging of display resulting in reduction of random noise.

Internal Preamp – Preamp can be switched in/out of circuit (flatness degrades above 600 MHz, provides approximately 12 dB sensitivity improvement).

Alternative Reference Level Units – dBm, dBmV, dBV, dBµV, dBµW, dBµV/m.

User-Definable Power-on Status – Instrument powers up to user-definable state or factory default condition.

Center Measure – Signal is centered with frequency and peak amplitude automatically read out (not a marker mode). The signal is counted in the 2712 or 2711 w/ Opt. 02.

Signal Track – Drifting signal is kept at display center with correct frequency and peak amplitude displayed.

Graticule Illumination – For CRT photography.

Direct Plot/Print – Supports Epson FX and LQ Series Printers and Tektronix HC100 Printer/Plotter via built-in GPIB interface (std 2712, 2711 Opt. 03), RS-232-C interface (Opt. 08, 2712 and 2711).

** Typical but nonwarranted performance parameters.*

*** Up to 108 saved displays, 36 front-panel setups available with Opt. 03 or 08.*

ORDERING INFORMATION

2712
Spectrum Analyzer ..... TD **$11,950**
Includes: Power cord (U.S. 115 V/60 Hz), Operator's Manual, Pocket Reference Guide, Programmers Manual, front cover, and N-to-BNC adapter.

2711
Spectrum Analyzer. ..... TD **$8,750**
Includes: Power cord (U.S.115V/60 Hz), Operator's Manual, front cover, and N-to-BNC adapter.

Opt. 02 – (2711 only) Add internal frequency counter with selectable 1 kHz/1 Hz readout resolution. .....**+$820**

Opt. 03 – (2711 only) GPIB Interface. Full programmability, direct print, additional NV RAM, and real-time clock. Cannot combine with Opt. 08.....**+$790**

Opt. 04 – (Cannot combine with Opt. 12 or 14/2712 only) Add internal tracking generator, 100 kHz-1800 MHz, 0 dBm to –48 dBm in 0.1 dB steps.....**+$3,150**

Opt. 07 – Add 2704 Inverter and 2705 Battery Pack. Includes: Power cord (U.S. 115 V/60 Hz), operator's manual, mounting plate.....**+$1,350**

Opt. 08 – (2712 only) Replace GPIB with RS-232-C interface.....**NC**

Opt. 08 – (2711 only, Cannot be combined with Opt. 03). RS-232 Interface, full programmability, direct print, additional NV RAM, and real-time clock.....**+$790**

Opt. 10 – Video monitor mode. .....**+$650**

Opt. 12 – (2712 only. Cannot combine with Opt. 04 or 14). Add Quasi-peak Detector (built-in). Includes: 200 Hz, 9 kHz, and 120 kHz EMC filters; 1 kHz and 1 MHz RBW filters.....**+$1,480**

NOTE: 200 Hz EMC filter replaces standard 300 Hz RBW filter.

Opt. 14 – (2712 only. Cannot combine with Opt. 04 or 12). Add 1 kHz, 10 kHz, 100 kHz, and 1 MHz RBW filters .....**+$600**

Opt. 15 – Tektronix 1405 TV Sideband Adapter interface .....**+$280**

Opt. 20 – EMC antenna set plus tripod and coax suitable for tests to 1 GHz (contact Tektronix Sales Engineer for more information).....**+$3,290**

Opt. 21 – Add 2706 Stepping RF Preselector .....**+$4,250**

Opt. 30 – Rackmount for 19 in. rack width, 5.25 in. height. .....**+$250**

Opt. 33 – Travel Line Package. Includes: accessory pouch, carrying strap, vinyl rain cover.....**+$100**

Opt. 34 – Portable-to-Rackmount Adapter for 19-in. rack width, 7 in. height.....**+$590**

INTERNATIONAL POWER PLUG OPTIONS

Opt. A1 – Universal Euro 220 V, 50 Hz.....**NC**

Opt. A2 – United Kingdom 240 V, 50 Hz .....**NC**

Opt. A3 – Australian 240 V, 50 Hz.....**NC**

Opt. A4 – North American 240 V, 60 Hz.....**NC**

Opt. A5 – Switzerland 220 V, 50 Hz.....**NC**

See Customer Information Section for additional description.

TD
Product also available within 24 hours through TekDirect. Call 1-800-426-2200

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

Spectrum Analyzers

Versatile, Low-Cost

ORDERING INFORMATION

WARRANTY-PLUS SERVICE OPTIONS

Opt. M7 – Calibration Service
2711 ..... **+$245**
2712 ..... **+$335**

Opt. M9 – Repair Protection
2711 ..... **+$490**
2712 ..... **+$670**

SOFTWARE

See pages 210 and 212 for additional information.

271x PC Utility Software – Order S26UT10 ..... **$575**

EMI Commercial Test Software – Order S26EMI2 ..... **$1,750**

PROBES

See page 423 for complete description.

Active – 4 GHz, 0.4 pF/100 kΩ, 1 M. Order P6217 ..... **$3,495**
750 MHz, 2 pF/1 MΩ, 1.5 M. Order P6205 ..... **$495**
TEKPROBE™ Power Supply. Order 1103 ..... **$450**

CAMERA/PLOTTER

See Camera Section for complete description.

Camera – Low cost. Order C-9 Opt. 1A & Opt. 20 ..... **$710**

Plotter – Four color. (GPIB) Order HC100 Opt. 01 ..... **$1,180**
(RS-232). Order HC100 Opt. 03 ..... **$1,075**

CART – K218 Instrument Cart **$695**

POWER SPLITTER – 75 Ω/50 Ω BNC Output, 50 Ω BNC Input.
Order 067-1232-00 ..... **$275**

CABLES, PADS, AND ADAPTERS

50 Ω Coaxial Cable –
BNC to BNC 5.5 in. Order 012-0214-00 ..... **$60**
BNC to BNC, 18 in. Order 012-0076-00 ..... **$31**
BNC to BNC, 42 in. Order 012-0057-01 ..... **$28**

75 Ω Coaxial Cable – BNC to BNC, 42 in.
Order 012-0074-00 ..... **$31**

GPIB Cables –
0.5 m. Order 012-1282-00 ..... **$150**
1 m. Order 012-0991-01 ..... **$170**
2 m. Order 012-0991-00 ..... **$170**
4 m. Order 012-0991-02 ..... **$260**

RS-232 Modem Cables –
9 pin female to 25 pin male. Order 012-1241-00 ..... **$70**
9 pin female to 9 pin female. Order 012-1379-00 ..... **$65**
9 pin female to 25 pin female. Order 012-1380-00 ..... **$60**

75 Ω to 50 Ω Minimum Loss Adapter – With DC block,
5.7 dB loss. Order 011-0112-00 ..... **$85**

75 Ω BNC to 50 Ω Type N Minimum Loss Attenuator –
Order 131-4199-00 ..... **$55**

75 Ω to 50 Ω Matching Attenuator – With 11.25 dB
conversion factor from dBm to dBV with DC block.
Order 011-0118-00 ..... **$95**

"F" Female to BNC Male Adapter – Order 013-0126-00 ..... **$22**

BNC Female to "F" Male Adapter – Order 103-0158-00 ..... **$14**

"N" Female to BNC Male Adapter – Order 103-0058-00 ..... **$15.50**

BNC Female 75 Ω to N Male 50 Ω Adapter –
Order 103-0273-00 ..... *1

75 Ω to 50 Ω Matching Transformer – 0.5 dB loss.
50 kHz to 300 MHz. Order 120-1883-00 ..... **$170**
5 MHz to 1 GHz. Order 120-1884-00 ..... **$170**

GPIB CARDS

PC-GPIB Card – IBM PC, AT, and compatibles.
Order S3FG210 ..... **$395**

AT-GPIB Card – IBM AT Bus (high speed card).
Order S3FG220 ..... **$495**

MC-GPIB Card – IBM PS2 with Microchannel Bus.
Order S3FG230 ..... **$495**

EMI Ancillary Devices – See pages 213 and 214.

ADDITIONAL ACCESSORIES

Service Manual –
2712. Order 070-8130-01 ..... **$135**
2711. Order 070-8130-01 ..... **$135**

Front Panel Cover – Order 200-2520-00 ..... **$12.25**

Transit Case – Order 016-0792-02 ..... **$460**

Soft Side Case – Order 016-1158-00 ..... **$120**

Rain Cover – Order 200-2520-00 ..... **$12.25**

Accessory Pouch – Mounts on top. Order 016-0677-02 ..... **$75**

Carrying Strap – Order 346-0199-00 ..... **$22**

TekMate Mounting Hardware – Order 016-1109-00 ..... **$70**

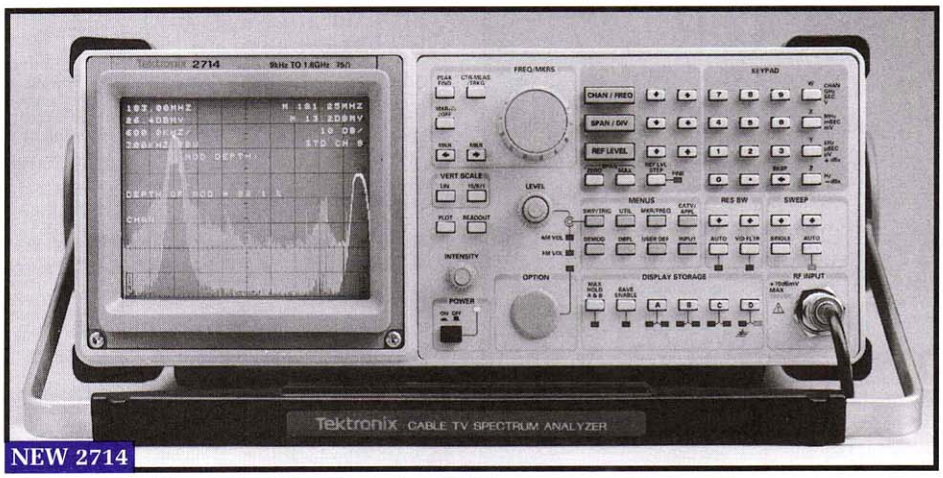
Viewing Hoods –
Collapsible. Order 016-0592-00 ..... **$16.50**
Binocular. Order 016-0566-00 ..... **$24**
Polarized. Order 016-0180-00 ..... **$80**

CRT Filter – Smoke Gray. Order 337-2775-02 ..... **$11**

**1 Please contact your local Tektronix representative for price and ordering information.*

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

Spectrum Analyzer
Cable TV



The 2714 simplifies cable TV and broadband LAN measurements.

New 2714 Cable TV Spectrum Analyzer

QUICK, REPEATABLE, PUSH-BUTTON MEASUREMENTS

The Tektronix 2714 Cable TV Spectrum Analyzer provides the ultimate in ease and economy for cable TV and broadband LAN measurements. It's cable ready with a 75 Ω BNC input that can be quickly changed to a 75 Ω F-connector input. All of the common cable system spectral measurements are built in and menu selectable including those needed to address field proof-of-performance requirements. Plus the accompanying PC software package adds measurement configuration, data collection, and automatic report generation capabilities.

What used to be complicated measurement procedures, even for engineering, are now push-button simple. Technicians can easily perform extensive cable system analysis and data collection in the field, all automatically.

Measurements and data collection can also be done remotely under computer control. Or the 2714 can be left unattended to run automatic measurements and data collection initiated by the built-in real-time clock.

Data collected in the field can be transferred from the 2714's memory via an RS-232 or GPIB interface to an MS-DOS personal computer (PC). The 2714's accompanying PC software package includes data archiving facilities as well as automatic report generation for proof-of-performance records.

BUILT-IN, AUTOMATIC MEASUREMENTS

The 2714 contains the following measurements and capabilities in its CATV Application menu:

- Automatic positioning of visual and aural carriers
- Visual and aural carrier levels and frequencies for selected channels
- Visual to aural carrier amplitude and frequency difference measurements for selected channels
- Survey of system visual and aural carrier levels and frequencies
- Depth of modulation
- Aural carrier deviation measurement
- Visual carrier-to-noise measurement
- In-channel response measurement
- Hum/low-frequency disturbance measurement
- System frequency response
- View baseband modulation (field and line) and demodulated video
- Aural carrier demodulation (listen mode)
- Distortion measurement (CTB/CSO)
- Cross-modulation measurement

2714

- Built-in Automatic Cable TV Measurements Enhance Measurement Repeatability and Reduce Technician Training Time
- Addresses All Field FCC Proof-of-Performance Requirements
- Key Cable TV Measurements Execute Automatically from Simple, On-screen Menu Selections
- Unattended and Remote Measurement Modes Reduce Personnel Requirements in the Field
- Full Programmability over RS-232 or IEEE-488 (GPIB) Interface
- Quick-change 75 Ω F and BNC Input Connectors
- Built-in Preamp, Audio, and AM/Wideband FM Video Demodulator

Cable Ready RF Testing from Tektronix. Highly portable with Selectable Digital and True Analog Display.

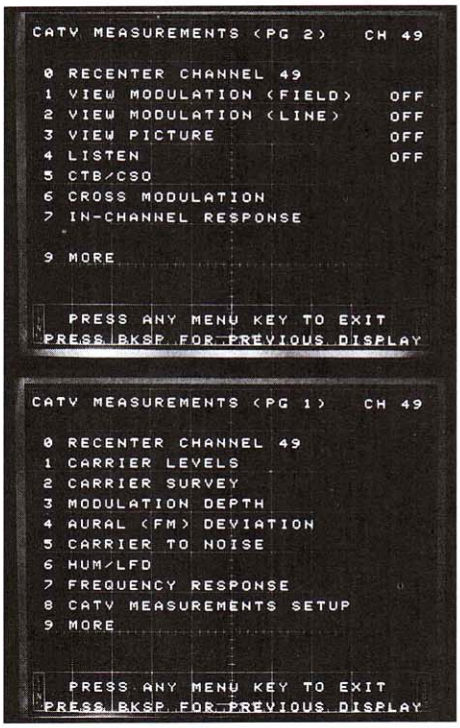
TD

Product also available within 24 hours through TekDirect. Call 1-800-426-2200

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

GPIB IEEE-488 The 2714 complies with IEEE Standard 488.1-1987, and with Tektronix Standard Codes and Formats.

Spectrum Analyzer
Cable TV

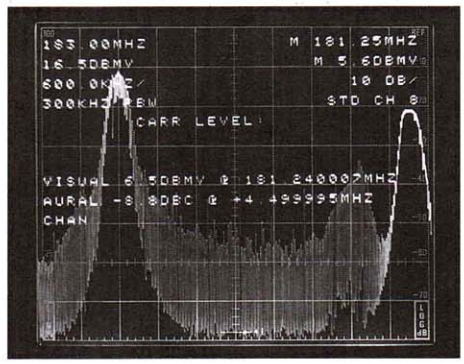


Pressing the CATV/APPL front-panel button provides easy access to the CATV Measurement Mode menu display

Measurements selected from the menu are automatically executed, and the results are displayed on the CRT screen. Not only are complex measurements reduced to push-button simplicity for less-experienced spectrum analyzer users, but measurement repeatability is high.

Measurement results can be output to a printer or plotter connected directly to the 2714's interface port. Results can also be automatically stored in the 2714's nonvolatile memory for later transfer to a PC. This, along with high portability, makes the 2714 ideal as an automatic data collection tool in the field for engineers and technicians alike.

A battery pack option makes 2714 measurements and data collection possible even where AC power isn't available.



Measurement conditions and results are clearly displayed on-screen. Text can even be added, to describe measurement location for example.

THE 2714 CAPITALIZES ON PC POWER

The PC-based software package that accompanies the 2714 runs automated cable TV measurements via an RS-232 or GPIB interface and provides a perpetual database for tracking system performance.

The software package provides the following capabilities:

Channel Table Generator – You can create your own custom channel tuning tables in addition to the standard tables provided. Result: Data will be consistently taken on all of your system carriers including scrambled channels, aeronautical offsets, and non-standard frequencies.

High-level Test Sequences – You can configure automatic test sequences from the 2714's built-in measurements. Creating a test sequence is a simple matter of indicating the desired tests in an on-screen setup matrix.

Report Generator – You can generate test and measurement reports that can be in any of several forms. These reports are directly usable for presentation of proof-of-performance data.

Historical Database – Data storage, archiving, and analysis for creating and comparing histories of previous measurements are provided.

Remote Control – Your PC can execute tests and measurements on a remotely located 2714 and receive results at the PC. Communication between the computer and the 2714 is through the RS-232 interface.

GENERAL PURPOSE CAPABILITIES

In addition to its special cable TV features, the 2714 also doubles as a highly capable, general-purpose spectrum analyzer. You get excellent RF performance, a built-in frequency counter, full programmability, enough nonvolatile memory for up to 108 saved displays and 36 front-panel setups, digital and true analog displays, high portability, and numerous other features, including field-changeable F and BNC connectors.

Characteristics Summary

CABLE TV MEASUREMENTS

The following specifications and features apply after a 15 minute warmup period and after all normalizations, including reference normalizations, have been performed. CATV characteristics represent typical performance and are dependent on general spectrum analyzer specifications. CATV characteristics need not be verified independently providing that all spectrum analyzer specifications are verified.

Channel Selection – Visual and aural carriers displayed when channel number is entered or front-panel selected.
Tune Configuration: STD, HRC, IRC, and custom; configured using 2714 PC software.
Channel Range: 0 to 999; configured using 2714 PC software.
Frequency Range: 1 MHz to 1.8 GHz; dependent on selected Channel Table.

Visual Carrier Frequency – Measured with internal counter to 1 Hz resolution with accuracy of 5×10^{-7} x Carrier Frequency ±10 Hz ±1 Least Significant Digit.

Visual-to-Aural Carrier Frequency – Aural carrier measured with internal counter relative to visual carrier.
Difference Range: 1 MHz to 10 MHz (depending on selected channel table) for an amplitude difference of ≤30 dB and aural carrier to noise ≥15 dB (300 kHz RBW).
Resolution: 1 Hz.
Accuracy: ±15 Hz for visual-to-aural carrier difference ≤8 MHz.

Visual Carrier Peak Level – Absolute peak amplitude measured with preamp off.
Amplitude Range: 18 dBmV to +58.8 dBmV for visual carrier to noise ≥30 dB (300 kHz RBW) and total input power ≤+70 dBmV.
Frequency Range: 15 MHz to 1015 MHz.
Resolution: 0.1 dB.
Absolute Accuracy: ±2.5 dB for visual carrier to noise ≥30 dB (300 KHz RBW); for FM signals, carrier to noise ≥33 dB (100 kHz RBW).
Relative Accuracy: ±0.5 dB relative to adjacent channel, ±1.2 dB relative to all others.

Visual-to-Aural Carrier Level Difference –
Difference Range: 0-30 dB for aural carrier to noise ≥15 dB (300 kHz RBW).
Resolution: 0.1 dB.
Accuracy: ±0.75 dB for aural carrier to noise ≥15 dB (300 kHz RBW).

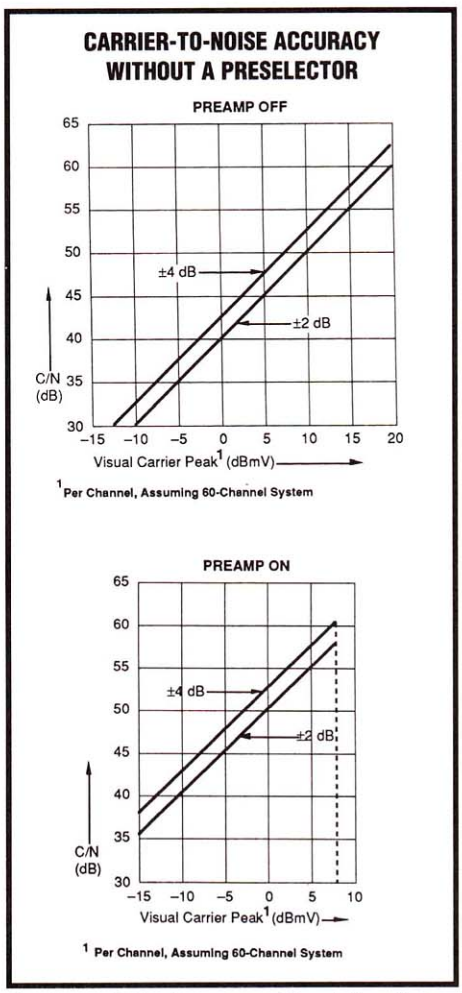
Modulation Depth – % AM measured from sync tip to lowest white level in 10 sweeps (VITS line used if defined in channel table).
AM Range: 50% to 95%.
Resolution: 0.1%.
Accuracy: ±2% for visual carrier to noise ≥40 dB (300 kHz RBW).

Spectrum Analyzer
Cable TV

Hum/Low-Frequency Disturbance – Power line frequency measured on an unmodulated visual carrier and low frequency disturbance measured on the modulated carrier.
AM Range: 1% to 10% peak-to-peak.
Resolution: 0.1%.
Accuracy: ±1% for hum ≤5% and visual carrier to noise ≥25 dB (300 kHz RBW); ±2% for hum, <10% and visual carrier to noise ≥25 dB (300 kHz RBW).

Carrier to Noise – Default noise floor is a normalized 4 MHz bandwidth measured relative to the visual carrier peak Range and Accuracy: See figure below.

Resolution: 0.3 dB.

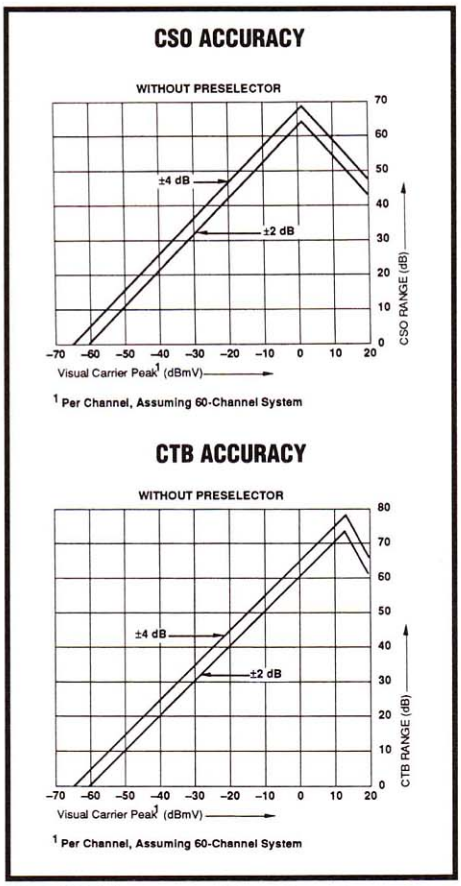


Carrier-to Noise Accuracy without Preselector.

CTB/CSO – Measured relative to visual carrier peak according to NCTA recommendations.

Range and Accuracy: See following figure.

Resolution: 0.3 dB.



CTB/CSO Accuracy without Preselector.

Frequency Response – For fixed-amplitude scrambling or no scrambling, system amplitude variations (flatness) are displayed relative to a reference trace stored during frequency-response reference setup.
Range: 5 dB/div.
Resolution: 0.2 dB.
Flatness Accuracy: ±0.75 dB.

In-Channel Response – Expresses maximum variance in amplitude within some specified frequency range within a particular channel, given a "flat" input over that same specified range. The variance is referenced to the average of the highest and lowest amplitude within the frequency range.
Range: ±3 dB.
Resolution: 0.1 dB.
Accuracy: ±0.5 dB.

Carrier Survey – Absolute peak amplitude of each visual carrier is measured and each associated aural carrier level is measured relative to the visual carrier for the selected channel. Frequency counted only when FAST SURVEY is disabled.

Aural (FM) Deviation – Peak FM deviation is measured for the selected channel.
Range: 10 kHz to 50 kHz; usable to 80 kHz.
Accuracy: ±4 kHz.

Cross Modulation – Peak of fundamental component of 3rd order distortion at horizontal sync frequency (AM) measured on the unmodulated visual carrier.
Range: 52 dB; usable to 65 dB.
Resolution: 0.1 dB.
Accuracy: ±2 dB for cross modulation <40 dB; ±3 dB for cross modulation <52 dB.

Listen Mode – Selected channel's aural carrier is FM demodulated and output fed to speaker or headphone jacks; instantaneous peak FM deviation is displayed.

View Picture Mode – NTSC or PAL visual carrier is demodulated and displayed.

View Modulation (Field) **–** One video field of the selected channel's video is displayed.

View Modulation (Line) **–** VITS line displayed; if VITS line isn't specified in channel table, line 17 displayed.
TV Line Selection: Via FREQ/MKRS knob.
Line Format: NTSC or PAL.
Line Range: 1-525 (NTSC); 1-625 (PAL).
Sweep Time: 10 µsec/div.

Spectrum Analyzer Specifications Summary

FREQUENCY RELATED

Frequency Range – 9 kHz to 1800 MHz.

Center Frequency Accuracy – 5 x 10^{-7} of center frequency ±700 Hz.

Frequency Counter Accuracy – 5 x 10^{-7} of center frequency ±10 Hz ±1 LSD (least significant digit).

Residual FM – ≤100 Hz p-p/20 msec at ≤20 kHz span/div; ≤2 kHz p-p/20 msec at >20 kHz span/div.

Resolution Bandwidth (–6 dB) **–** 5 MHz, 1 MHz, 300 kHz, 100 kHz, 30 kHz, 10 kHz, 3 kHz, 1 kHz, and 300 Hz.

RBW Shape Factor (60 dB/6 dB) **–** ≤7:1 for RBW ≤1 MHz.

Noise Sidebands – ≤–70 dBc at 30 x RBW for RBW ≤100 kHz.

Frequency Span/Div Range – 100 MHz to 1 kHz selected in 1-2-5 sequence or any value from 100 MHz to 1 kHz via the keypad or UTIL menu, plus 180 MHz and 0 Hz.

Span Accuracy – ±3% measured over the center eight divisions.

AMPLITUDE RELATED

Flatness – ±2 dB (relative to reference level at 100 MHz) measured with 10 dB internal RF attenuation (preamp off).

Vertical Display Modes – 10, 5, 1 dB/div., Linear.

Display Dynamic Range – 80 dB maximum (Log Mode); 8 divisions maximum (Linear Mode).

Continued on next page.

Spectrum Analyzer
Cable TV

RF Attenuation Range – 0 to 50 dB in 2 dB steps.

Maximum Sensitivity (at 300 Hz RBW) – –78 dBmV (–127 dBm); –90 dBmV (–139 dBm) with preamp on.

SPURIOUS RESPONSE (PREAMP OFF)

3rd Order IM Distortion – ≤–70 dBc from any two on screen signals with any frequency span.

2nd Harmonic Distortion – ≤–66 dBc measured with 1st mixer input level of ≤+9 dBmV.

INPUT RELATED

RF Input – 75 Ω BNC with quick change to 75 Ω type F connector.

VSWR – With RF Attenuation ≥10 dB: 1.5:1 maximum to 1 GHz. With 0 dB RF Attenuation: 2:1 maximum to 1 GHz.

Maximum Safe Input – +70 dBmV (0.1 W or 2.2 V) continuous peak with 100 VDC blocking capacitor.

1 dB Compression Point – ≥+34 dBmV (–15 dBm) with 0 RF attenuation and 1st mixer at +19 dBmV (–30 dBm.)

ENVIRONMENTAL

Temperature – Operating: 0° to +50°C (MIL T-28800E). Nonoperating: –55° to +75°C.

Humidity – Nonoperating: Five cycles (120 hours) in accordance with MIL-Std 28800E, Class 5.

Vibration – Meets MIL T-28800E, Method 514, Procedure X (modified).

Shock – Operating and nonoperating: Three guillotine-type shocks of 30 g, one-half sine, 11 ms duration each direction along each major axis; total of 18 shocks.

Altitude – Operating: 15,000 ft. Nonoperating: 50,000 ft.

Radiated and Conducted Emissions – Meets FCC Part 15, Subpart J, Class A and VDE 0871, Class B.

GENERAL CHARACTERISTICS

Power Requirements – 105 W maximum (1.4 A) at 115 V, 60 Hz: operates 48 Hz to 440 Hz, 90 to 132 VAC, or 48 Hz to 63 Hz, 90 VAC to 250 VAC; battery power option available.

Weight – <10.2 kg (22.5 lbs) nominal for basic configuration.

Dimensions (H,W,D with Feet, Handle, and Front-Panel Cover) – 137 x 361 x 445 mm (5.4 x 14.2 x 17.5 in).

Note: Full specifications are available in the 2714 Cable TV Spectrum Analyzer Data Sheet, Tektronix Literature number 2EW-8705-0.

ORDERING INFORMATION

2714
Cable TV Spectrum Analyzer ..... TD **$14,200**
Includes: PC Software, power cord (U.S. 115 V/60 Hz), User Manual, Programmer Manual, Software Reference Manual, front cover, 75 Ω BNC connector, 75 Ω F connector, and choice of GPIB or RS-232 interface (Opt. 03 or Opt. 08).

Opt. 03 – Provides an IEEE-488 General Purpose Interface Bus (GPIB) as a no-cost option (not compatible with Opt. 08) ..... **NC**
Opt. 07 – Add low-cost battery pack ..... **+$1,350**
Opt. 08 – Provides an RS-232 port as a no-cost option (not compatible with Opt. 03) ..... **NC**
Opt. 15 – Add 1st local oscillator output for a 1405 TV Sideband Analyzer ..... **+$280**
Opt. 30 – Rackmount adapter for 19 x 5.25 in. rack dimensions ..... **+$250**
Opt. 33 – Travel Line package; includes: rain cover, accessory pouch, gray CRT filter, and carrying strap ..... **+$100**
Opt. 34 – Portable-to-rackmount adapter for 19 x 7 in. rack dimensions ..... **+$590**
Opt. B1 – Service Manual ..... **+$135**
Opt. B2 – Additional set of manuals ..... **+$240**

INTERNATIONAL POWER PLUG OPTIONS
Opt. A1 – Universal Euro 220 V, 50 Hz ..... **NC**
Opt. A2 – United Kingdom 240 V, 50 Hz ..... **NC**
Opt. A3 – Australian 240 V, 50 Hz ..... **NC**
Opt. A4 – North American 240 V, 60 Hz ..... **NC**
Opt. A5 – Switzerland 220 V, 50 Hz ..... **NC**
See Customer Information Section for additional description.

WARRANTY-PLUS SERVICE OPTIONS
Opt. M7 – Calibration Service ..... **+$400**
Opt. M9 – Repair Protection ..... **+$795**

SOFTWARE
See page 210 for additional information.
271x PC Utility Software – Order S26UT10 ..... **$575**

CAMERA/PLOTTER
See Camera section page 408 for complete description.
Camera – Low cost. Order C-9 Opt. 1A and Opt. 20 ..... **$710**
Plotter – Four color. Order HC100 Opt. 01 ..... **$1,180**
CART – K218 Instrument Cart **$695**

CABLES, PADS, AND ADAPTERS
75 Ω Coaxial Cable –
BNC to BNC 42 in. Order 012-0074-00 ..... **$31**
BNC to BNC 24 in. Order 012-1339-00 ..... **$45**

F Series input adapter/connector replacement.
Order 103-0301-00 ..... **$20**
BNC input adapter/connector replacement.
Order 103-0310-00 ..... **$36**
GPIB Cables –
0.5 m. Order 012-1282-00 ..... **$150**
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9 pin female to 9 pin female. Order 012-1379-00 ..... **$65**
9 pin female to 25 pin female. Order 012-1380-00 ..... **$60**
25 pin male to 36 pin male. Order 012-1250-00 ..... **$50**
"F" Female to BNC Male Adapter – Order 013-0126-00 ..... **$22**
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MC-GPIB Card – IBM PS2 with Microchannel Bus.
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Transit Case – Order 016-0792-02 ..... **$460**
Soft Side Case – Order 016-1158-00 ..... **$120**
Rain Cover – Order 200-2500-00 ..... **$12.25**
Accessory Pouch – Mounts on top. Order 016-0617-02 ..... **$75**
Carrying Strap – Order 346-0199-00 ..... **$22**
TekMate Mounting Hardware – Order 016-1109-00 ..... **$70**
Viewing Hoods –
Collapsible. Order 016-0592-00 ..... **$16.50**
Binocular. Order 016-0566-00 ..... **$24**
Polarized. Order 016-0180-00 ..... **$80**
CRT Filter – Smoke Gray. Order 337-2775-02 ..... **$11**

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GPIB IEEE-488 — The 2714 complies with IEEE Standard 488.1-1987, and with Tektronix Standard Codes and Formats.

Spectrum Analyzer
Software

S26UT00
S26UT10

S26RF00
S26RM00
S26RM01

MAIN MENU MAP

MEASUREMENTS
- Harmonic Distortion
- Amplitude Modulation
- Signal-to-Noise
- Frequency Response
- Cursors

SIGNAL SEARCH
- Fast Search
- Precise Search
- Spur Search
- Automatic Identify

UTILITIES
- Talk/Listen
- Sensitivity Test
- Resolution Filter Test
- Calibration Assistance
- Select Instrument
- Select Disk

FILTER TESTS
- Band-pass Filters
- Low-pass Filter
- High-pass Filter

WAVEFORM OPERATION
- Acquire AVIEW Waveform
- Acquire BView Waveform
- Send to Instrument
- Redraw Waveform
- Store on Disk
- Load from Disk
- Graph Waveform
- Overlay Waveform
- Normalize Waveform

The GRASP main menu lists all submenus and their routines.

Automate Your Measurements with Tektronix Spectrum Analyzer Software

Tektronix Spectrum Analyzer Software is designed to automate and simplify your spectrum analyzer measurements. Connect your spectrum analyzer to an IBM PC or compatible, load the software, and begin making measurements. Applications and utility routines are selected through easy, menu-driven operation. Results are displayed on the computer screen and can be printed, plotted, or archived to disk.

S26RF00 General RF Applications Software Package

Tektronix' GRASP (General RF Applications Software Package) is designed to capitalize on the power of Tektronix' 490P, 2750P, and 2790 Series Spectrum Analyzers and PC-compatible controllers.

This highly versatile software package offers many applications/utility routines that are selected through easy, menu-driven operation. Even a non-technical operator has immediate access to operations such as swept-frequency measurements, waveform storage and recall, and performing signal analysis, including measurements of harmonic distortion and signal-to-noise ratio.

From GRASP's main menu, a user selects among any of the submenus for Measurements, Filter Tests, Signal Search routines, Waveform Operations, and Utilities. Selections are made by pressing the appropriate function key shown on-screen.

Prompts guide the user through each measurement task. For example, users can use a Cursors routine which displays the instrument CRT on their terminal screen. It calculates and displays both the absolute amplitude and frequency of one or two marked signals, plus the relative (delta) amplitude and frequency difference between the two markers.

Complete source code is provided, thereby simplifying the task of integrating user-written routines into GRASP.

S26UT00 278X/PC Utility Software

Tektronix's 278X/PC Utility Software is designed to capitalize on the power of the Tektronix 2782 and 2784 Spectrum Analyzers and PC-compatible controllers.

This software package offers applications/utility routines that are selected through pop-up menu operation. Even a non-technical operator has immediate access to operations such as waveform graphing, waveform storage and recall, and performing a fast or precise signal search over a selected frequency band. A Talk/Listen routine is also included for explicitly setting or querying any front-panel function.

All tests are based upon user-defined defaults. The results of the tests can then be displayed on screen, or stored to disk for later recall. Graphics drivers are included for both CGA (Color Graphics Adapter) and EGA (Enhanced Graphics Adapter) displays. Graph colors are user-selectable.

Continued on next page.

S26RF00

General RF Applications – (GRASP)
- Spectrum Analysis on PC-Compatible Computers
- Easy, Menu-Driven Operation
- VGA, EGA, and CGA Graphics

S26UT00

278X/PC Utility Software
- Spectrum Analysis on PC-Compatible Controllers
- Pop-up Menus
- Data Logging to Color Copier, Printer, or Magnetic Media.
- VGA, EGA, and CGA Graphics

S26RM00/S26RM01

Remote Site Monitoring (RSM)
- Control Tektronix Instrumentation from Anywhere in the World
- Monitor RF Signals at Remote Installations

S26UT10

271X/PC Utility Software
- Extends the Storage Capabilities of the 271X Spectrum Analyzer
- GPIB and RS-232 Interface Control
- Built-in Graphics Driver Supports Dot-Matrix Printers
- User Friendly Interface
- Performs Automated Spectrum Analysis Using PC-Compatible Controllers

Automate your measurements with Tektronix Spectrum Analyzer Software.

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

S26UT00
S26UT10

S26RF00
S26RM00
S26RM01

Spectrum Analyzer
Software

MONITOR
- Enter Parameters
- Take A Measurement
- Report Errors
- Hang-up/Monitor
- Immediate Call Back
- Show Parameters

MEASUREMENTS
- Harmonic Distortion
- Amplitude Modulation
- Signal-to-Noise

SIGNAL SEARCH
- Fast Search
- Precise Search
- Spur Search

WAVEFORM OPERATIONS
- Acquire A View Waveform
- Acquire B View Waveform
- Send to Instrument
- Store on Disk
- Load from Disk
- Graph Waveform
- Acquire Mode: Norm

UTILITIES
- Talk/listen (Command)
- Sensitivity Test
- Resolution Filters Test
- Calibration Assistance
- Select Instrument
- Select Disk
- User Program

RSM provides a variety of routines for signal monitoring and interactive testing.

S26RM00/S26RM01 Remote Site Monitoring PC Software

RSM (Remote Site Monitoring) software simplifies the control and data analysis of instruments at remote sites or in hostile environments. RSM merges the power and precision of Tektronix's 490P, 2750P, and 2790 Series Spectrum Analyzers with the economy of PC-based controllers to provide cost effective, remote-site monitoring and control.

RSM provides the ability to connect, via telephone, a pair of PCs. The remote-site PC is connected to the remote Tektronix 490P, 2750P, and 2790 Series Spectrum Analyzer, and perhaps to other Tektronix programmable instruments, via the IEEE 488 interface. This remote PC includes a National Instruments GPIB card. The 2402A TekMate, when ordered with a graphics card, makes an ideal remote-site PC.

The host-site PC is located at a convenient location such as an office or lab. At the host site, the user has complete control over the operations of the remote-site PC, and all screen displays seen are identical to those currently appearing at the remote site, including full color.

From RSM's main menu, a user selects any of the submenus for Monitor, Waveform Operations, Utilities, Measurements, and Signal Search. Each of these submenus and the included routines are accessed through a pop-up menu structure.

The Monitor menu contains several routines that control the operation of the Independent Automated Signal Monitoring mode. RSM continually checks the RF input signals to the remote spectrum analyzer and compares them to a user-defined frequency/amplitude tolerance window. The user can define all monitoring parameters, verify pass/fail conditions of the current setup, initiate monitoring, and report all current and logged errors.

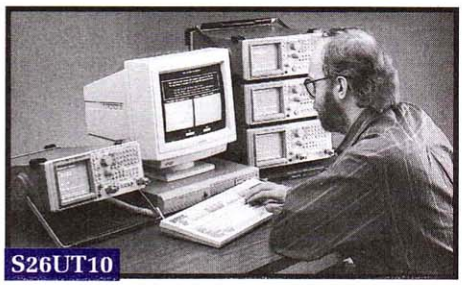
The Monitor menu includes a Hang-Up/Monitor routine which terminates any existing phone connection between the host and remote sites and initiates the signal monitoring routine as specified. If the signal drops out of the previously defined amplitude/frequency window, an automatic telephone call is placed to the host site to alert the operator to the error condition.

The Waveform Operations menu provides several routines, such as acquiring and graphing one or more signals, storing and loading waveforms to disk, and sending waveforms back to the analyzer for display.

The Utilities menu includes a Talk/Listen routine that sends commands and queries to the spectrum analyzer or other Tektronix instruments at the remote site. This menu also allows inclusion of a user-written program to perform tasks such as automated signal surveillance of a set of communication channels.

The Measurements and Signal Search menus provide a variety of routines for performing tasks such as measuring harmonic distortion and amplitude modulation, as well as performing a precise signal search over a specified frequency range.

For maximum flexibility, the RSM system is offered in two packages: a host-site module (S26RM00) and a remote-site module (S26RM01). At least one of each module is required to comprise a working remote monitoring system. Both modules are provided with source code.



271X/PC Utility Software facilitates repetitive measurements for automated testing.

S26UT10 271X/PC Utility Software

Tektronix' 271X/PC Utility Software is designed to extend the storage capabilities as well as automate some of the more common functions of the 271X Spectrum Analyzers. These include waveform acquisition, graphing, documentation, storing to disk, comparing, subtracting, recalling from disk, and sending to the analyzer. Both single traces and groups of related traces can be manipulated.

The software provides utility routines for operations such as TALK/LISTEN (sending commands and receiving responses), selecting the color of waveform graphs and annotation, and specifying the drive or path under which waveforms and other files will be stored.

The software includes an application category which can be supplemented with user specific applications. This category contains a waterfall application, an occupied bandwidth measurement application, and an application to save, recall and transfer User Defined Programs to other 271X analyzers equipped with a communications port.

The measurement category contains a program to measure harmonic distortion and a program to check swept frequency response. The latter uses the optional, fully programmable 271X tracking generator to measure peak-to-valley response within a specified frequency range.

ORDERING INFORMATION

GRASP Software Package – Order S26RF00 ..... **$875**
Includes: Software (see choice of media under Options), license agreement, and User's Manual.

Utility Software for 2782/2784 – Order S26UT00 ..... **$1,400**
Includes: Software on DS/DD diskettes, license agreement, and User's Manual.

RSM Host-Site – Order S26RM00 ..... **$300**

RSM Remote-Site – Order S26RM01 ..... **$750**
Includes: Software on DS/DD diskettes, license agreement, and User's Manual.

Opt. 01 – (GRASP only) IBM AT high-density disk (1.2 Mb, 5.25 in.) ..... **NC**

Opt. 1A – (GRASP only) IBM PC double-density disk (360 kb, 5.25 in.) ..... **NC**

Opt. 1B – (GRASP only) IBM PC microdisk (720 kb, 3.5 in.) ..... **NC**

Opt. 10 – GPIB interface for PC ..... **+$495**

PC Utility Software – For 271X Series. 5.25 in. and 3.5 in. disks. Order S26UT10 ..... **$575**

Opt. 09 – Source Code ..... **+$1,000**

Opt. 10 – GPIB Interface for PC ..... **+$495**

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

EMC Solutions

Measurement Systems

EMC Measurement Solutions Affordable and Effective

The time to address Electromagnetic Compliance (EMC) is before it becomes an expanding problem. Proper attention to EMC from the design stage through pre-certification testing can reduce your product development time and lower your cost to market.

Tektronix wants to share its EMC experience and expertise with you. For over 40 years Tektronix has been a world leader in the design and production of spectrum analyzers, oscilloscopes, logic analyzers, and a wide variety of other high-technology electronic devices. In support of these products, we have established and maintained a substantial in-house EMC testing facility, and evolved effective measurement systems and methodologies. The knowledge gained has had an important influence on the EMC measurement tools and solutions described in this section.

EMC Measurement Systems

NEW TEKTRONIX 27120 EMC PRE-/POST-CERTIFICATION MEASUREMENT SYSTEM

Maximize the probability that your product will be certified the first time through the EMC testing lab. Minimize the cost of delays resulting from scheduling and re-testing your products. Insure continued compliance in the months and years after certification. Help achieve these objectives with the Tektronix 27120 Pre-/Post-Certification Measurement System!

The Tektronix S26EM12 PC-based EMC software package provides a straightforward means of controlling the 27120 system and managing measurement results. The software facilitates FCC, CISPR/EC, VDE, VCCI, and other commercial product testing. The easy-to-use 9 kHz – 1.8 GHz 2712 Spectrum Analyzer includes many features helpful in identifying and measuring EMC signals: built-in pre-amp, frequency counter, audio demodulator, true analog or 4-trace digital display, peak, quasi-peak, and average detection, and 200 Hz, 9 kHz, and 120 kHz EMI filters. Overload capability is enhanced and ambient signal interference is minimized by the 2706 Stepping RF Preselector. Biconical and log-periodic antennas, a tripod and feedline, and a LISN with transient limiter enable you to make radiated measurements from 30 MHz to 1 GHz and conducted measurements from 9 kHz to 30 MHz. Magnetic and electric near-field RF probes for EMC troubleshooting round out the system. All together, this is a complete but very economical package for addressing all of your EMC diagnostic and pre- and post-certification needs. More details on the 2712 Spectrum Analyzer are available on page 201 to 204.

For additional information on making EMC measurements with Tektronix Spectrum Analyzers, software, and associated equipment, ask your local Tektronix Sales Office for a copy of *EMC Measurement Solutions*, 2EW-8793-0.

27120

PRE-/CERTIFICATION MEASUREMENTS

- Verify Performance Before Purchasing Expensive and Difficult-to-Schedule Laboratory Time

COMPLIANCE MAINTENANCE

- Establish Benchmarks and Detect Deviations
- Make Relative and Absolute Measurements to Ensure Product Continues to Meet EMC Standards

EMC systems and tools designed to meet your EMC testing needs.

ORDERING INFORMATION

27120

EMC Pre-/Post-Certification Measurement System *1

Opt. 08 – RS232 Interface (Replaces GPIB) *1

Opt. 10 – Video Demodulator *1

INTERNATIONAL POWER PLUG OPTIONS

Opt. A1 – Universal Euro 220 V, 50 Hz ..... **NC**

Opt. A2 – United Kingdom 240 V, 50 Hz ..... **NC**

Opt. A3 – Australian 240 V, 50 Hz ..... **NC**

Opt. A4 – North American 240 V, 60 Hz ..... **NC**

Opt. A5 – Switzerland 220 V, 50 Hz ..... **NC**

See Customer Information Section for additional description.

WARRANTY-PLUS SERVICE OPTIONS

Contact your local Tektronix sales office for available warranty options.

**1 Please contact your local Tektronix representative for price and ordering information.*

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

GPIB IEEE-488 — The 2711/12 complies with IEEE Standard 488.1-1987, and with Tektronix Standard Codes and Formats.

EMC Solutions
Software

Tektronix PC-Based Software Automates Tedious EMI Measurements.

S26EM00

EMI Software

- Cost-Effective Approach to Automated EMI Testing
- Runs on IBM or Compatible PC
- Easy, Menu-Driven Operation
- Pre-Certification Testing for FCC/VDE, MIL-STD 461B/462 CE03 and RE02.

S26EM12

Commercial EMI Test Software

- Cost-Effective Approach to Automated EMI Testing
- Runs on IBM/Compatible PC
- Easy, Menu-driven Operation
- Configure and Save Test Set-ups with User-defined Steps and Frequency Ranges
- Define and Save User-specified Test Limits
- Perform Tests to User-defined or Standardized Limits
- Define and Save User-specified Correction Factors
- Graphically Display Multiple Test Results
- Automate Spectrum Analyzer Compression Tests

S26EM00
EMI Prequalification Software

Tektronix' EMI Prequalification Software provides a low-cost, time-saving approach to EMI conducted and radiated emissions testing using Tektronix' 490P, 2750P, and 2790 Series Spectrum Analyzers. It is particularly designed for engineers who require a compact system for measuring and documenting MIL STD. EMI levels during the various design stages.

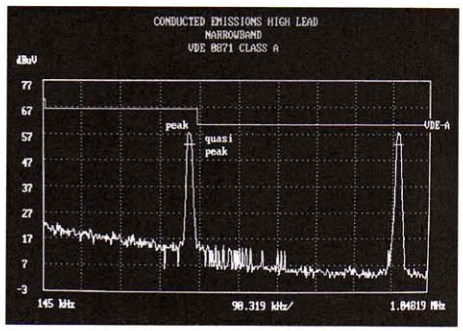
When used with a Tektronix 490P, 2750P, and 2790 programmable spectrum analyzer and an IBM or compatible PC (equipped with a National Instruments IEEE-488 interface card), this software enables a cost-effective approach for integrated EMI testing. This software package includes test routines for FCC Part 15 Subpart B, VDE 0871, and MIL-STD 461B/462 RE02 and CE03. Routines are accessed through, menu-driven operation. For each class of test, routines are provided for acquiring data, graphing results (semilog plot with selected limits superimposed), and creating printouts of frequencies approaching or exceeding limits. Capability is also included for updating and displaying antenna factors.

For information about ordering antennas and other EMC test equipment, see Ancillary Devices or contact your Tektronix sales engineer.

S26EM12
Commercial EMI Test Software

Tektronix' Commercial EMI Test Software provides a powerful engineering tool for integrating EMI testing into product design cycles.

The EMI software automates the testing and data recording procedures required to analyze the Equipment Under Test (EUT) against U.S. or international test requirements, over a frequency range of 1 kHz to 1.8 GHz. Routines and provisions are included for compliance to FCC, VDE, and CISPR standards. This comprehensive software package runs radiated emissions, magnetic emissions, conducted emissions, and radiated power tests. Measurements can also be made against user-defined limits. The software supports peak, quasi-peak, and average detection methods and controls most Tektronix spectrum analyzers and the 2706 Stepping RF Preselector.



Graphic display of Peak and Quasi-Peak Measurements.

The software works with your IBM PC or compatible computer. Hardware requirements are modest; a GPIB interface, 512K bytes of RAM, a hard disk, and any size flexible disk drive. Color graphics take better advantage of the software's features (EGA or VGA is recommended), but monochrome is supported too. A run-time function library module (for Microsoft QuickBASIC) is included, as well as sample test setups and results.

Tektronix S26EM12 EMI Software allows test systems to be set up in shielded rooms, at open-field sites, or at the engineering bench. All acquired test data are stored to disk, and can be viewed immediately in graphic or text formats, or archived for later review and report generation. Test results are stored as ASCII characters so they can be used by other analysis software.

Testing is completely menu-driven from the computer keyboard and display. Test results can be automatically graphed on the monitor screen, or plotted on HP-GL or Epson-compatible plotters. They can also be printed on Epson FX-compatible or HP LaserJet compatible printers. Additionally, tabular test results can be printed on an Epson-FX or compatible line printer.

A free demo disk is available by calling the Tektronix National Marketing Center at 1-800-426-2200, Ext. 99.

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

ORDERING INFORMATION

EMI Prequalification Software – Order S26EM00 ..... **$1,475**
Includes: Software on DS/DD diskettes, license agreement, and User's Manual.
Opt. 10 – GPIB Interface for PC ..... **+$495**

Commercial EMI Test Software – Order S26EM12 ..... **$1,750**
Includes: 5.25 in., 3.5 in. media and documentation.
Opt. 10 – GPIB Interface for PC ..... **+$495**
EMI Ancillary Devices – See page 214.

EMC Solutions

Stepping RF Preselector

New 2706 Preselector

The 2706 Stepping RF Preselector facilitates distortion-free measurements in the presence of large signals at the spectrum analyzer input. If total signal power at the first mixer stage of the spectrum analyzer exceeds the 1 dB compression point, inaccurate amplitude measurements can result. The 2706 Stepping RF Preselector enables the spectrum analyzer user to make accurate measurements over a wider range of signal environments by:

- Significantly attenuating undesired out-of-band signals
- Reducing power from high spectral density pulsed signals
- Reducing total power by minimizing the number of individual signals present at the analyzer input

Use of commercial RF preselectors has been limited because of high costs. Now, Tektronix offers an affordable and cost-effective solution for pre-certification testing.

The Tektronix 2706 Stepping RF Preselector is designed for use with spectrum analyzers for EMI measurements and other applications. The 2706 can be attached to the bottom of 271X Spectrum Analyzers to form a compact test unit. Signals present at the 2706 input connector are routed directly to the spectrum analyzer when preselection is not desired. When preselection is desired, one of eight bandpass filters is switched into the circuit to limit signals to the frequencies of interest.

The 2706 is a stepping RF preselector using band switching to select the desired bandpass frequencies. Automatic operation is provided via a GPIB interface and is supported by Tektronix S26EM12 EMI Software. Correction-factor tables are provided with each 2706 so specific losses for each of the various bands can be entered into the Tektronix EMI software for automatic compensation.

Characteristics

FREQUENCY RELATED

Bypass Mode – Frequency Range: 9 kHz to 1800 MHz. Insertion Loss (max): 2.0 dB.

Filters – Frequency Range: 9 kHz to 1800 MHz in eight switch-selectable ranges. Bandpass/Highpass Flatness: 1.5 dB max.

INPUT RELATED

RF Input/Output connectors – Type N.

Input/Output Impedance – 50 Ω nominal.

VSWR (max) – 1.8:1.

Ultimate Rejection, Stop Band – 60 dB typical. 40 dB min. below 500 MHz and 30 dB min. above 500 MHz.

Maximum Input – +20 dBm, 50 VDC

Switching Speed (max) – 10 ms.

IEEE 488 Interface Support – AH1, L4, SH1, T6, SR1, PP1, DC1, DT0, RL1, C0, E1, TE0, and LE0.

GENERAL CHARACTERISTICS

Power Requirements – 90 to 250 VAC, 48 to 63 Hz, 10 W maximum.

Weight – 5.9 kg (13 lbs).

Dimensions (H, W, D) – 8.8 x 32.7 x 43.1 cm (3.46 x 12.87 x 16.97 in.).

2706

- Low Investment
- Easy to Use
- Part of Automated Measurement System Using Tektronix S26EM12 EMI Software
- By-Pass Mode Facilitates Measurement without Preselection
- Can be Easily Taken to Remote Measurement Sites
- Can be Used as a Stand-Alone Filter in Many Other Applications
- 9 kHz to 1800 MHz Overall Range (By-Pass Mode)
- Continuous Bandpass Filtering from 9 kHz to 1800 MHz in Eight Selectable Bands
- Compact, Light-Weight Design
- Attaches to the Tektronix 271X Spectrum Analyzers to Form Integrated Unit

An affordable preselector solution for pre-certification measurements.

ORDERING INFORMATION

2706

Stepping RF Preselector **$4,450**

Includes: Power Cord (U.S. 115 V, 60 Hz), Operator's Manual.

Opt. 01 – 271X Spectrum Analyzer Mounting Hardware and RF Interconnect Cable ..... **+$300**

NOTE: The 2706 Opt. 01 Stepping RF Preselector is available at a reduced price when ordered as an option to the 2711 or 2712 Spectrum Analyzers (see page 203).

INTERNATIONAL POWER PLUG OPTIONS

Opt. A1 – Universal Euro 220 V, 50 Hz ..... **NC**

Opt. A2 – United Kingdom 240 V, 50 Hz ..... **NC**

Opt. A3 – Australian 240 V, 50 Hz ..... **NC**

Opt. A4 – North American 240 V, 60 Hz ..... **NC**

Opt. A5 – Switzerland 220 V, 50 Hz ..... **NC**

See Customer Information Section for additional description.

SOFTWARE

See pages 209, 210, and 212 for complete description.

Commercial EMI Test Software – Order S26EM12 ..... **$1,750**

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

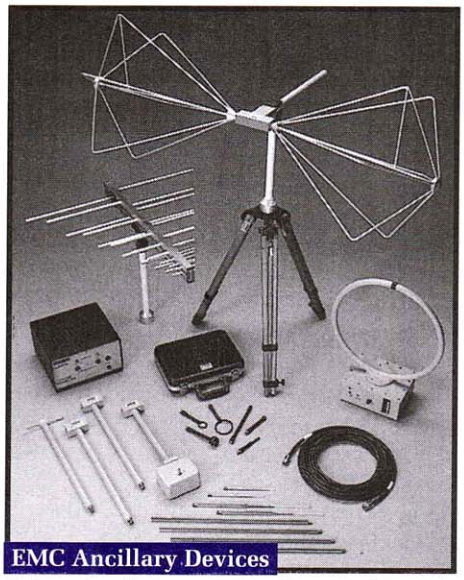
EMC Solutions

Ancillary Devices

Sensors and EMI pick up devices for EMI testing.

EMC ANCILLARY DEVICES

- Loop Antenna
- Adjustable-Length Dipole
- Biconical Antenna
- Log-Periodic Antenna
- RF probe set
- LISN
- Transient Limiter
- 10m Coaxial Cable
- Adjustable Tripod



Tektronix offers a complete line of calibrated antennas and other sensor products for EMI testing.

EMC Ancillary Devices

Sensors, or EMI pickup devices, are required for EMI testing. A sensor picks up the EMI signal and couples it to the spectrum analyzer. The spectrum analyzer then displays the EMI signal as a plot of amplitude (vertically) versus frequency (horizontally).

The type of sensor needed depends on the test standard and the type of test (radiated or conducted electric field, or radiated magnetic field). For radiated electric (E) field tests, a biconical, log periodic, or dipole antenna may be used. Magnetic loop antennas are used for magnetic (H) field tests.

The specific transducer type required also depends on the test standard and frequency range. Tektronix has available a line of antennas and other sensors, as shown in the table.

Tektronix also offers a Line-Impedance Stabilization Network (LISN), used for conducted emissions testing. It is inserted between the power source and the EUT. An output on the LISN couples EMI in the power line to the spectrum analyzer's input.

EMC ANCILLARY DEVICE SELECTION GUIDE/ORDERING INFORMATION

Device	Frequency Range	Application Information	Order No.	Price
Loop Antenna	9 kHz to 30 MHz	Radiated H-field (magnetic) emissions. Active loop provides gain and low-frequency sensitivity.	119-4144-00	**$2,495**
Adjustable-length Dipole	28 MHz to 1 GHz	Radiated E-field emissions/CATV leakage. Ideal for EMI testing and site attenuation measurements. Includes four baluns.	119-4145-00	**$2,695**
Biconical Antenna	30 MHz to 300 MHz	Radiated E-field emissions. Broadband frequency capability eliminates need for band switching, element extension or external tuning.	119-4148-00	**$1,295**
Log-periodic Antenna	200 MHz to 1 GHz	Radiated E-field (electric) emissions. Linearly polarized design permits separate measurement of horizontal and vertical fields. Broadband frequency.	119-4142-00	**$1,550**
RF Probe Set	9 kHz to 1.8 GHz	Locate RF "Hot Spots." Useful in diagnostic testing phase in EMI compliance investigation. Includes five probes plus extension.	119-4146-00	**$520**
LISN	10 kHz to 100 GHz	Facilitates measurement of conducted emissions on power line from equipment under test. Filters undesired signals imported on mains supply	119-4147-00	**$2,395**
Transient Limiter	9 kHz to 100 GHz	Use with LISN to prevent inadvertant damage to spectrum analyzer input	011-0164-00	*1
10 m Coaxial Cable	NA	Couple antenna to spectrum analyzer (male fittings).	012-1291-00	**$150**
Adjustable Tripod	NA	Mounting for all above antennas. Wooden frame reduces field disturbance.	016-1102-00	**$295**

**1 Please contact your local Tektronix representative for price information.*

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

Inverter/Battery Pack

2704 Inverter/2705 Battery Pack

The 2704 Inverter and 2705 Battery Pack can provide for operation of 271X Spectrum Analyzers in locations where AC power is not available. These units mount directly on the spectrum analyzer to form a portable package.

They can also be used for other remote applications requiring 115 V, 60 Hz power. Maximum continuous output power is 125 watts.

Several 2705s can be used to provide an uninterruptible power source for the spectrum analyzer or other equipment. The 2704 includes a battery charger, and provides an auxiliary 18 volt output. The 2704 also accepts 12 volt input from other sources, such as car batteries. These units are described in more detail in Tektronix Specification/Ordering Information Sheet 26W-7061.

Characteristics

2704 INVERTER

DC input – (main & auxiliary) 11.25 VDC to 15 VDC.

Battery Protection Shutdown – 10 VDC ±5%.

Output Voltage – 115 VAC RMS ±10%.

Output Frequency – 60 Hz ±5%.

Output Waveform – Quasi-sinusoid, 1.3 crest factor.

Output Power – 125 W continuous.

Battery Charger – AC input voltage (90 VAC to 250 VAC, 50/60 Hz), (90 VAC to 125 VAC, 400 Hz). AC power consumption 70 Watts max.

Auxiliary Output for LNB Voltage – 18 VDC ±10%. Ripple, noise 100 mV pk-pk max. Maximum output current 1 A, (current limited).

2705 BATTERY PACK

Type – Sealed lead-acid, 12 V, 15 Amp-hr.

Voltage Range – 10 VDC to 14.4 VDC.

Minimum Operating Time – 50 min at 10°C to 40°C, 45 minutes at 0°C to 10°C.

Charging Time (using 2704) – Less than 8 hours for 1 battery pack, less than 12 hours for 2 battery packs, fully discharged state, 0°C to 40°C.

Cycle Life – ≥125 charge/discharge cycles to 100%.

2704/2705

- Easy Connection to Tektronix 271X Family Spectrum Analyzers
- 125 Watts of AC Power
- Continuous Power Using Sequential Battery Packs
- Lightweight Single Package for Easy One-handed Carrying
- Automatic Charging of Two Battery Packs Simultaneously
- Auxiliary 18 VDC LNB Power
- Low Battery Warning

Operate your 271X Spectrum Analyzer when Mains Power is not available.

TD
Product also available within 24 hours through TekDirect. Call 1-800-426-2200

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

GPIB IEEE-488 — The 2704 and 2705 complies with IEEE Standard 488.1-1987, and with Tektronix Standard Codes and Formats.

ORDERING INFORMATION

2704
Inverter ..... TD **$1,050**
Includes: Power cord (U.S. 115 V, 60 Hz), Operator's Manual, Analyzer Mounting Plate.

2705
Battery Pack ..... TD **$310**

1.5-Meter DC Power Cord – 2704 inverter-to-automotive cigarette lighter plug. Order 118-8549-00 ..... **$43**

1.5 Meter DC Power Cord – 2704 inverter-to-alligator clips. Order 118-8550-00 ..... **$43**

INTERNATIONAL POWER PLUG OPTIONS

Opt. A1 – Universal Euro 220 V, 50 Hz ..... **NC**
Opt. A2 – United Kingdom 240 V, 50 Hz ..... **NC**
Opt. A3 – Australian 240 V, 50 Hz ..... **NC**
Opt. A4 – North American 240 V, 60 Hz ..... **NC**
Opt. A5 – Switzerland 220 V, 50 Hz ..... **NC**

See Customer Information Section for additional description.

Fourier Analyzers

Advanced Analysis of Analog and Digital Signals in the Time and Frequency Domains, from DC to 200 kHz.

2622/2630/2642A
NEW 2600DA

- Real time Spectrum, Network (Frequency Response), and Waveform Analysis
- Complete Modal System for Structural Analysis
- Accessory Software for Control Systems Analysis, Production Tests, 1/3 Octave Analysis, Spectral Maps, and More
- Easy-to-Learn Pull-Down Menus
- Up To Four Input Channels
- Optional Built-in Signal Generator with Periodic, Random, and Arbitrary Analog Signal Generation

Fourier Analyzers

PC INTEGRATED

Fourier Analyzers from Tektronix provide the most advanced architecture in bench-top instrumentation available today. From their inception, Fourier Analyzers have been designed to carefully integrate the advancing technology of personal computers with the precision and speed of dedicated measurement hardware. The result is a continuously evolving, high-quality measurement system dedicated to the analysis of analog signals and the properties they represent.

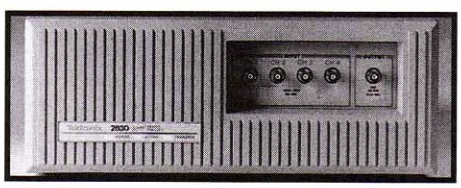
Within each Tek Fourier Analyzer is a combination of precision signal-acquisition hardware and microprocessors specifically designed for high-performance signal processing.Connected to a PC, the Fourier Analyzer's internal processors have access to the PC's display, I/O ports, mass storage, and keyboard. In short, the PC becomes the terminal for a powerful Fourier analysis system.

FLEXIBLE

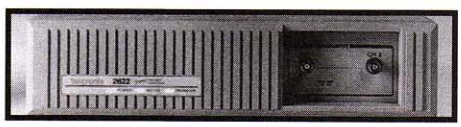
The Instrument Program (IP) supplied with the Fourier Analyzer is the critical link between the analyzer and the PC. When it is executed from the PC, all of the Fourier Analyzer's instructions are downloaded into the analyzer's internal RAM, providing the latest features and capabilities. IP then uses the PC's display to generate the Fourier Analyzer's user interface – complete with high resolution graphics and easy-to-learn pull-down menus.

From the keyboard, or using a mouse, you have access to a wide variety of analysis functions and data presentations. Standard functions include:

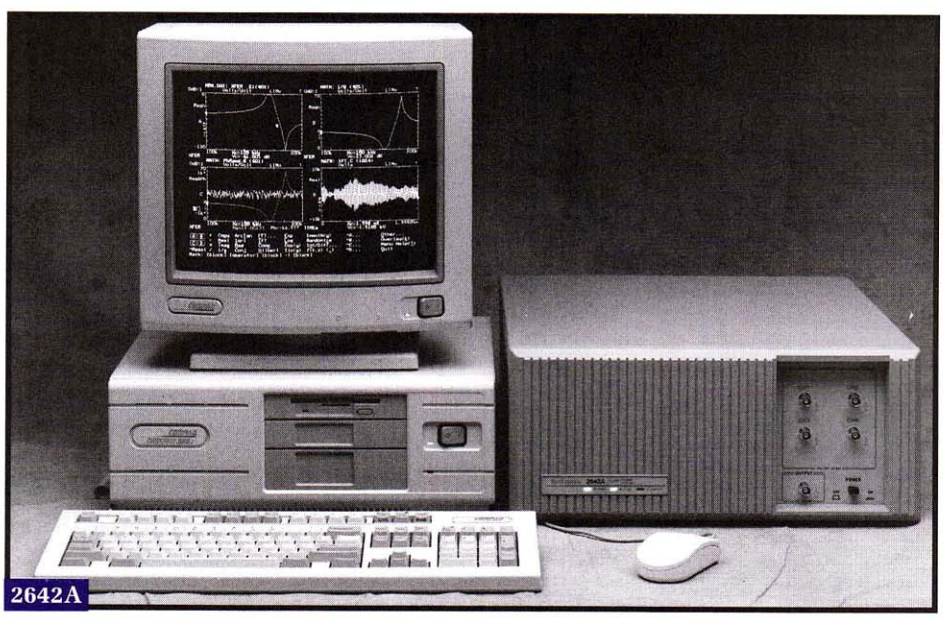
- Time Record (Waveform)
- Orbits (Lissajous)
- Auto- and Cross-Correlation
- Power Spectrum for each Channel
- Frequency Response Functions Between any Two Channels
- Impulse Response
- Real, Imaginary, Magnitude, Phase, and Nyquist Displays
- Advanced Data Cursors



2630 Fourier Analyzer – DC-20 kHz



2622 Fourier Analyzer – DC-20 kHz



2642A Shown with Desktop PC

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

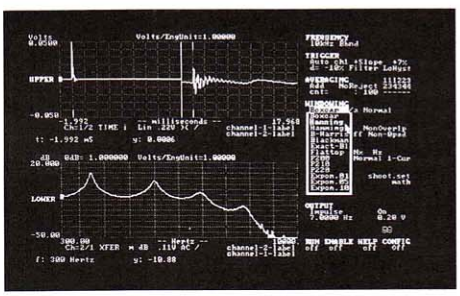
Fourier Analyzers

2622
2630
2642A

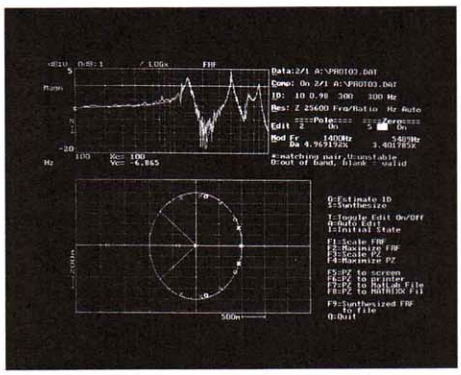
POWERFUL

While IP satisfies the majority of measurement needs, the utility of the analyzers is further enhanced with these additional standard programs:

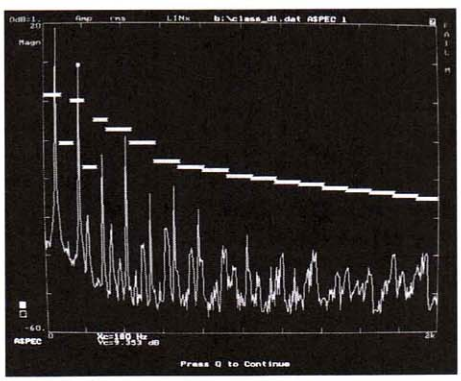
- Transient Capture 500K Samples (Std) up to 3.5 M Samples (2642 A with Opt. 6M) or 1.5 M Samples (2622/2030 with Opt. 2M).
- Measure automated measurement program.
- Waveform Math Program with 17 standard (+ – * /) and advanced (cepstrum, openloop mapping) operations for general purpose waveform manipulation.
- Swept sine testing for measurement conditions requiring maximum signal to noise ratio (built-in signal generator required).
- Other display, hardcopy, and data translation utilities.



The Instrument Program provides high-quality color graphics and easy-to-learn pull-down menus for data analysis and acquisition control.



One of many accessory software packages, the RLS System Identification software produces pole/zero system models from measured stimulus/response data.



Production Test Manager Software allows fully automated production testing for noise, vibration, electrical system performance or other applications.

ADVANCED SOLUTIONS

In addition to the standard software, optional accessory programs extend the capabilities of the Fourier Analyzer – providing everything from advanced tools to complete solutions for a variety of applications.

Production Test Automation – The Production Test Manager is a series of programs designed to dramatically reduce the development time for creating automated production tests using Fourier Analyzers. Using the LIMITS program, test limits can be defined quickly using a table of values, previously measured data, or rubber-band style graphics. Other routines provide failure report generation, results archiving, multiple limit checks for quality sorting, a simple pass/fail operator interface, and many more standard functions. Executed individually or included in larger programs, these routines can replace hundreds of lines of program code saving valuable time and money.

Control System Analysis – The optional RLS and CFIT System Identification programs (RLS shown in photo) analyze time or frequency domain stimulus/response data to produce system models expressed as poles and zeros in either the S or Z planes. For further analysis, the pole/zero models can be passed on to powerful system development programs such as PC-MATLAB.™

Acoustics and Vibration – When monitoring acoustic signals, the optional Third Octave program provides 1/3 octave analysis of up to four signals simultaneously.

The Machine program automatically labels significant vibration peaks and allows switching among displacement, velocity, and acceleration displays.

Modal Analysis – The 2600MS Structural Analysis Solution includes the TekSTAR data acquisition manager software plus SMS STARModal or STARStruct analysis software, for a complete, turn-key structural analysis package. Interfaces to other modal analysis software are also available. Large channel count modal tests can be accomplished economically using FastSCAN software.

Spectral Maps and Order Tracking – The 2600SMT software provides capabilities for the analysis of signals which change over time, such as rotating machinery, speech, or underwater device tracking. Three dimensional displays include waterfall plots and color intensity maps to permit viewing changes in amplitude and frequency versus either time or RPM. Detailed analysis of individual orders, frequencies, or spectra is also possible.

Continued on next page.

Fourier Analyzers

2600 Systems

2622

The 2622 is a small, lightweight, two channel analysis system with a very economical price. Primary applications include production line testing and education. When the integrated system controller (Opt. 33) is added, it becomes an ideal transportable system for machinery, vibration, or acoustic analysis.

2630

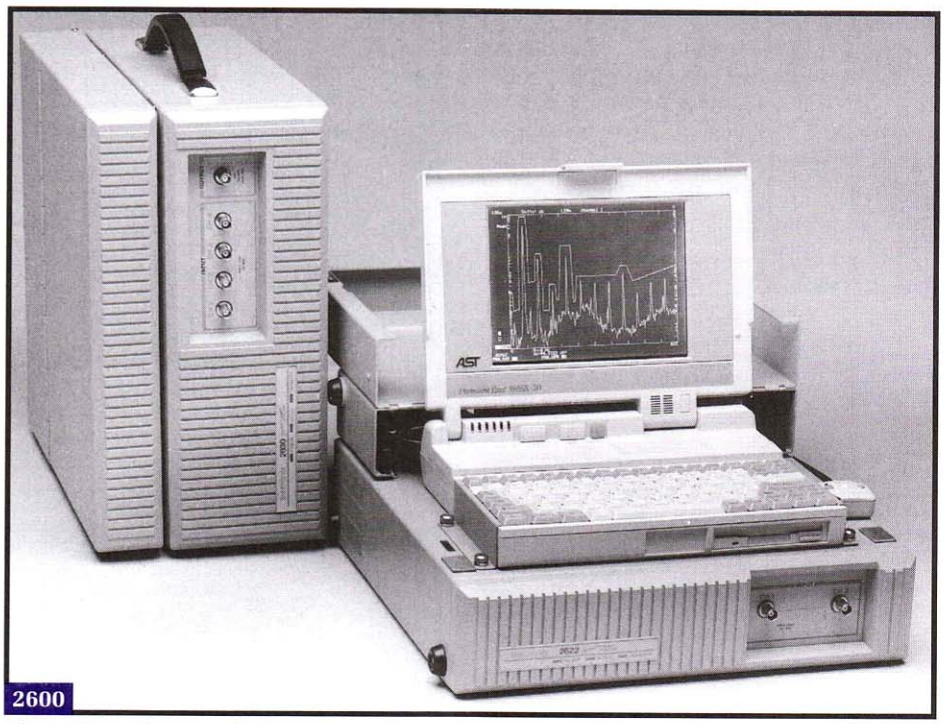
The 2630 is a two or four input channel system with an optional signal generator. The system's flexibility and PC integration make it perfect for applications such as modal analysis, control system analysis, or general signal and system analysis. When your data record length exceeds the analyzer's transient capture buffer and even the 1.5 M Sample Large Data Memory option isn't enough, Option 5H Data Record/Playback streams data directly to the host PC's hard disk, allowing virtually unlimited record lengths. The four channel configuration also makes it possible to production test three or four units at a time, greatly increasing throughput. An integrated PC, transportable configuration is also available.

2642A

The 2642A is the flagship of the 2600 line, providing dedicated DSP performance for a pace-setting 200 kHz realtime bandwidth, and full floating-point FFT processing for maximum precision. It offers two 200 kHz input channels, zoom processing, and an arbitrary output generator standard at an extremely attractive price. Extended performance (16-bit) input channels, a large data memory, an integrated controller, and two additional input channels may be added. Applications include electronic systems analysis, sonar and underwater acoustics, speech analysis, and numerous others.

2600DA

The 2600DA enhances the capabilities of any of the 2600 analyzers by providing measurement and excitation functions in the digital domain. This allows performance verification of DSP based mixed-signal designs such as modems, cellular telephone, control systems, medical instruments, and more. Two digital input channels plus a digital output channel, serial or parallel interfacing, independent clocking signals per channel, and buffering for burst input capability make this powerful measurement tool simple to use.



The 2600 Analyzers with integrated PC (Opt. 33) become complete analysis systems that easily travel with you.

SELECTION GUIDE

	2622	2630	2642A
Frequency Range	20 kHz	20 kHz	200 kHz
Input Channel	2	2 (4 with Opt. 1H)	2 (4 with Opt. 1H or 17)
Max Realtime BW	5 kHz	10 kHz	100 kHz
Dynamic Range	75 dB	75 dB	75 dB (90 dB* with Opt. 16 or 17)
Channel Match	±0.2 dB, ±0.5 deg	±0.2 dB, ±0.5 deg	±0.075 dB*, ±0.5 deg
Spectral Lines	25 to 800	25 to 1600	25 to 1600
Zoom	Opt. 2H	Opt. 2H, 3H	Std.
Signal Generator	–	Opt. 4H	Std.
Data Rec/Playback	–	Opt. 5H	–
Weight	12 lb. (5.5 kg)	17 lb (7.7 kg)	27 lb (12.3 kg)

(DC – 50 kHz)

Fourier Analyzers

ORDERING INFORMATION

2622
2-CH Standard **$6,950**
Opt. 2H – 2-CH Zoom ..... **+$500**
Opt. 2M – Large Data Memory (add 2 MByte) ..... **+$800**

2630
2-CH Standard **$9,950**
Opt. 1H – Four Input Channels ..... **+$3,950**
Opt. 2H – 2-CH Zoom ..... **+$500**
Opt. 2M – Large Data Memory (add 2 MByte) ..... **+$800**
Opt. 3H – 4-CH Zoom ..... **+$1,000**
Opt. 4H – Signal Generator ..... **+$1,750**
Opt. 5H – Data Record/Playback ..... **+$3,150**

2642A
2-CH Standard **15,900**
Opt. 1H – Four Input Channels ..... **+$7,000**
Opt. 16 – Two 16-bit Input Channels ..... **+$4,000**
Opt. 17 – Four 16-bit Input Channels ..... **+$15,000**
Opt. 6M – Large Data Memory (add 6 MByte) ..... **+$2,400**
All products include IP, MEASURE, TCAP, SEEFILE, MATH, SWSINE, PLT, ASCIILNK*1

CONTROLLER OPTIONS FOR ALL ANALYZERS (2622, 2630, AND 2642A)
Opt. 23 – Notebook System Controller ..... **+$4,125**
Opt. 26 – Desktop System Controller ..... **+$3,540**
Opt. 33 – Integrated System Controller ..... **+$4,900**

2600DA
Digital Measurement Adapter **$5,000**

*1 **IP (Instrument Program)** – For general signal analysis
*1 **MEASURE** – For automated measurements
*1 **TCAP** – For capture to memory of transient data
*1 **SEEFILE** – For analysis of captured transients
*1 **MATH** – For waveform arithmetic
*1 **SWSINE** – For transfer function analysis using swept sine excitation
*1 **PLT** – For advanced data plotting and display
*1 **ASCIILNK** – For data conversion to formats suitable for input into other analysis software (PC-Matlab, MATRIXx, spreadsheets, etc.)

Application Development Kit – Includes Borland's Turbo Pascal and a collection of high level subroutines (analyzer control, data display, menu driver, etc.) to allow custom application program development. Order 2600ADK **$1,200**

Application Utilities – A collection of application routines developed by Tektronix to address specific testing needs. Examples include 1/1 and 1/3 octave analysis, THD measurements, and probability density measurements. Order 2600AU **$950**

FastSCAN – Automates large channel count measurements by controlling multi-channel scanners and managing the resulting database. Order 2600FS **$750**

TekSTAR – Provides a highly integrated interface between IP and PC modal analysis software packages. Drivers are available for most commercially available modal software. Order S3JMS05 ..... **$250**

STARModal and STARStruct – Offer a complete PC based modal and structural analysis solution from the leaders in PC modal software, Structural Measurement Systems.
STARModal – (Includes TekSTAR) Order 2600MS **$7,500**
STARStruct – Order 2600MS with Opt. 01 ..... **$16,600**

PC-MATLAB – Signal processing software from The MathWorks provides tools for control system development and other system modeling applications. Includes MATLAB, Signal Processing Toolbox, and Control Systems Toolbox. Order 2600PCM **$1,685**
386-MATLAB – Order 2600PCM with Opt. 01 ..... **$2,585**

Production Test Manager – Acquires data and compares it to manually defined or automatically generated limits. Includes pass/fail operator interface, error reports, data archiving, and serial number tracking. Order 2600PTM **$2,500**

Spectral Maps and Order Tracking – Provides three dimensional displays (waterfalls or intensity maps), order tracking, RPM extraction, and other features for transient analysis. Order 2600SMT **$1,500**

RECOMMENDED ACCESSORIES
Probes – See Probe Section page 423.
Cart – See Cart Section page 418 for complete description. Order K335 ..... *2

MINIMUM PC REQUIREMENTS
Fourier Analyzers operate with an IBM PC, XT, AT, PS/2 or 100% compatible having the following minimum configuration: DOS 3.0 or higher, RAM – 640 kilobytes, One 3 1/2 or 5 1/4 in. floppy drive and 20 megabyte Hard Drive, One RS-232-C serial port, Intel 8087, 80287, or 80387 Co-processor, Enhanced Graphics Adapter (EGA), Monochrome or color EGA monitor (Second serial port and mouse recommended).

INTERNATIONAL POWER PLUG OPTIONS
Opt. A1 – Universal Euro 220 V, 50 Hz ..... **NC**
Opt. A2 – United Kingdom 240 V, 50 Hz ..... **NC**
Opt. A3 – Australian 240 V, 50 Hz ..... **NC**
Opt. A4 – North American 240 V, 60 Hz ..... **NC**
Opt. A5 – Switzerland 220 V, 50 Hz ..... **NC**
Also see General Customer Information Section.

WARRANTY-PLUS SERVICE PLANS OPTIONS
Opt. M7 – Calibration Service
2622 ..... **+$300**
2630 ..... **+$350**
2642A ..... **+$400**

Opt. M9 – Repair Protection
2622 ..... **+$695**
2630 ..... **+$765**
2642A ..... **+$975**

*1 *Included with 2622, 2630, 2642A.*
*2 *Please contact your local Tektronix representative for price and ordering information.*

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

2500 Series TestLab

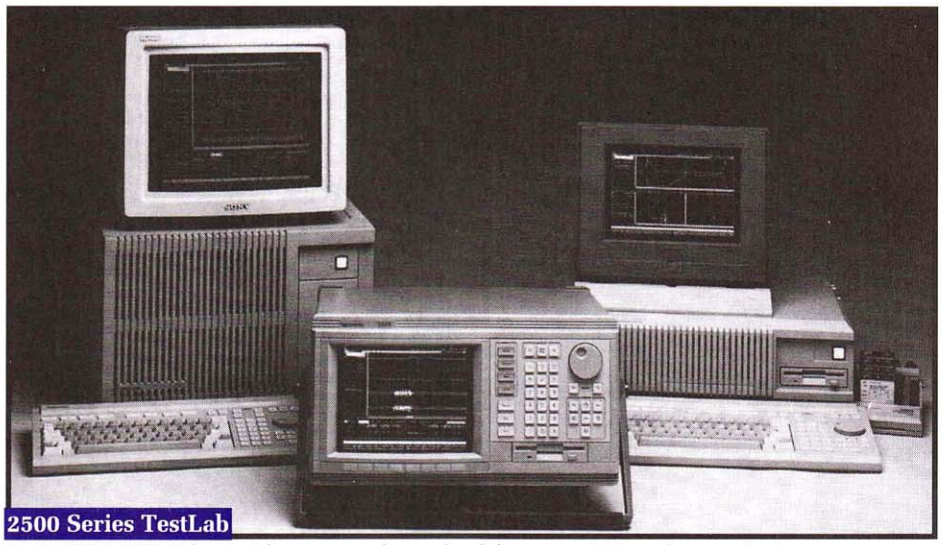
Basic features of oscilloscopes, paper-based recorders, and personal computers integrated into one instrument.

2500 SERIES

- Portable: up to 16 Channels in a Briefcase-sized Package
- Simultaneous Acquisition: 2 to 48 Differential Analog Channels
- Long Records: Up to 1 million Samples per Channel
- Data Analysis: Powerful Visual Analysis and Custom User-Entered Formulas
- Read Signal Magnitudes in Engineering Units
- Data Management: Many Tests with Many Channels Conveniently Organized and Presented

APPLICATIONS:

- Mechanical System and Component Testing
- Manufacturing Process Development, Documentation and Troubleshooting
  - Semiconductor
  - Steel
  - Plastics
- Electrical Power Distribution and Switching
- Fluid Power Control Systems



2500 Series TestLab provides 2 to 48 channels of data acquisition, data analysis and data management.

TestLab™ Multi-Channel Waveform Analyzers

The 2500 Series TestLab presents a new problem-solving capability to scientists, engineers and technicians. TestLab integrates into one instrument key features of oscilloscopes, paper-based recorders and personal computers. TestLab's key advantages include:

- Reduce test set-up time with simple connections and automatic acquisition parameter settings.
- Look at the whole system under test – 2 to 48 channels of simultaneous data.
- Understand your data easily – powerful data analysis.
- Handle many tests and many channels – straight-forward data management and test notation.

SYSTEM CONFIGURATION

Three mainframes (2505, 2510 and 2520) allow configuring for up to 8, 16 or 48 12-bit, differential analog channels, respectively. An equal number of digital-event channels accommodate high/low, on/off types of signals.

Use TestLab in the lab or the field. In the field, use the 2505 or 2510 (8 or 16 channels) of data acquisition in a package about the size of a briefcase. In the lab, the 2520 rack-mountable lab configuration provides extended channel count (up to 48) and a color display or the 2510 with a color display.

TestLab is card modular. Any of three acquisition cards may be installed in any of the mainframes to provide flexibility in channel count, record length and bandwidth. The acquisition cards may be mixed or matched in the 2510 or 2520.

DATA ACQUISITION

The 2510 and 2520 accommodate multiple acquisition cards. Acquisition cards may be mixed or matched to suit the testing requirement. The sampling speed of each acquisition card may be set independently. Faster signals (e.g. transients) may be captured at a faster rate and slower signals at a slower rate over a longer period of time. All data, across all channels is time synchronous - there is no time skew between channels.

Data may be captured with record lengths of milliseconds to days at up to 12-bit vertical/magnitude resolution (1 part in 4096). Voltage or unit offsets are easily dialed in. Input voltage ranges from ±100 mV to ±100 V.

Triggering for each channel may be set independently with magnitude and slope (+, –, either). Channels may be logically ANDed and ORed together to define very specific triggering conditions.

TestLab's auto save capability allows unattended operation. Triggered acquisitions are automatically saved to disk until the user-specified number of tests have been achieved.

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

2500 Series TestLab

DATA ANALYSIS

See up to 16 signals on the display simultaneously. View stored data with newly acquired data in stacked, overlay or X-Y display formats. Zoom and pan data for a close look. Dual cursors provide precise signal magnitude and event relationship measurements. Read magnitudes in engineering units.

Analyze data with waveform mathematics. No programming is necessary. Built-in waveform mathematical functions include + – * / ^, sine, cos, tan, differentiate, integrate, Log_{10}, Ln, RMS, Standard Deviation, FFT and many more.

Export data and set-up parameters to host computers. Formats include: WKS, ASCII, Binary, DADisp® and user defined.

DATA MANAGEMENT

Saved test parameters, notes and data are conveniently organized in a spreadsheet-like format. Waveforms within tests are easily added to the display for viewing with other saved data or with newly acquired data. Documentation notes can be printed as hardcopy for indexing purposes.

DATA ARCHIVING

All saved tests are time and date stamped and stored with setup parameters on internal hard disk or floppy disk.

HARD COPY & REPORT GENERATION

Hardcopy options include: Dot-matrix printer (single button-press to initiate copy) or plotter (HPGL format). Waveforms may be printed or plotted to a file for later printing/plotting or for importing into word processing programs for report generation.

Optional Signal Conditioning Accessory 25BP4

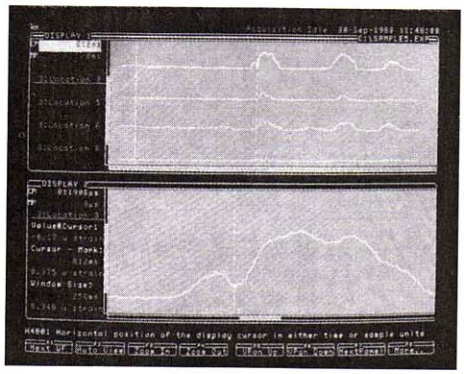
ACQUISITION CARDS

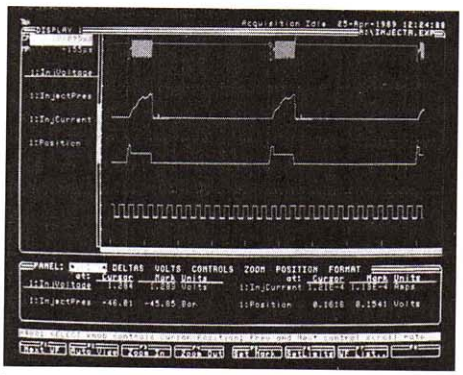
	Acquisition Card 25AD3	Acquisition Card 25AA2	Acquisition Card 25AA1
Vertical Amplifiers Input	8 analog channels with independent A/D converters for simultaneous acquisition and 8 digital event channels	2 analog channels with independent A/D converters for simultaneous acquisition	4 analog channels with independent sample and hold for simultaneous acquisition
Channel Type	Single-ended or differential Selectable per channel	Single-ended	Single-ended or differential Selectable per channel
Input Ranges	±100 mV to ±100 V Full Scale in 1, 2, 5 sequence	±100 mV to ±50 V Full Scale in 1, 2, 5 sequence	±100 mV to ±10 V Full Scale in 1, 2, 5 sequence
Vertical Resolution	12 bit	10 bit	12 bit
Input Impedance	1 MΩ	1 MΩ	1 MΩ
DC Offset	±15 V minus the selected FS range from ±100 mV to ±10 V ranges. ±150 V minus the selected FS range from ±20 V to ±100 V ranges	NA	±15 V minus the selected FS range
CMRR	–60 dB at 100 Hz (up to ±10 V)	NA	–60 dB at 100 Hz
Crosstalk	–40 dB at 100 Hz	–60 dB at 100 Hz	–40 dB at 100 Hz
Acquisition Memory	64 K samples per channel (standard) 512 K and 1 M samples per CH (optional)	64 K samples per channel	256 K samples for 4 channels
Time Base Sample Rate	1 S/min to 100 KS/s	200 S/sec to 12.5 MS/s	12.5 S/sec to 100 KS/s (multiplexed)
Resolution	10 µsec per point minimum. Selectable in increments of: 10 µsec up to 100 ms 1 ms up to 60 sec	80 ns per point minimum. Selectable in increments of 80 ns	10 µsec per point minimum. Selectable in increments of 2 µsec
External Clock	Full range of sample rate	NA	Full range of sample rate
Triggering Level Range	100% of full scale (plus offset)	100% of full scale	100% of full scale (plus offset)
Level Resolution	0.5% of full scale	1.0% of full scale	0.5% of full scale
Slope	+, –, Either, or Off	+, –, Either, or Off	+, –, Either, or Off
Window Mode	Yes	NA	NA
Programmability	Logical OR, logical AND combination of individual trigger criteria from each channel (analog or digital)	Logical OR combination of individual trigger criteria from each channel	Logical OR combination of individual trigger criteria from each channel
Pretrigger Range	Pretrigger and record length and are selectable in 1 sample increments	Pretrigger and record length and are selectable in 1 sample increments	Pretrigger and record length and are selectable in 1 sample increments

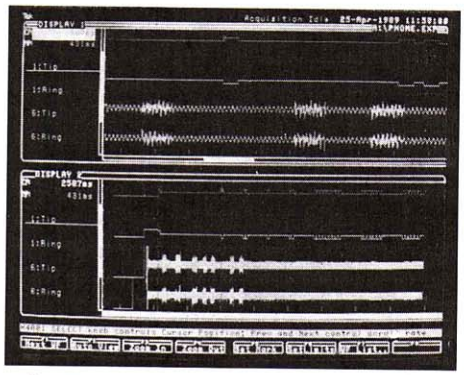
Continued on next page.

2505
2510
2520

2500 Series TestLab







Powerful display system allows user configured formats for different applications–without writing software.

Characteristics

The 2505, 2510 and 2520 are identical in feature set and capability except in where specified in the following description:

DISPLAY

Resolution – 640 x 350 pixels for all displays.

2505: Built-in 9 in. monochrome.

2510: Multi-synch color monitor or electroluminescent flat panel.

2520: Multi-synch color monitor.

Waveform Display – Two independent display windows; in each display up to 8 stacked waveforms, or XY plot w/zoom.

Cursors – A cursor and mark in each display window provide cursor measurements on each displayed waveform. Both may be linked together and/or linked between the two display windows.

ACQUISITION

Single-shot triggered, repeat triggered, roll (chart recorder emulation), roll direct to disk, auto-save to disk at the end of the acquisition cycle.

Acquisition characteristics are dependent on acquisition cards used (see accompanying chart). Number of acquisition cards accommodated in each mainframe: 2505 – 1 acq card; 2510 – 2 acq cards; 2520 – 6 acq cards.

DATA STORAGE

Internal Hard Disk – 40 Mb standard, 80 Mb optional.

Internal Floppy Disk – MS-DOS formatted 3.5 in, 720 Kb.

DATA EXPORT & FORMAT CONVERSION

Move data to PCs via diskette or bus.

Format Conversions – Lotus 1-2-3® .WKS, ASCII, Binary, custom.

HARD COPY

Epson compatible dot matrix printer with Centronix interface. HPGL plotter.

INTERFACING

IEEE-488 (GPIB), RS-232C via COMM Pack module. GPIB command set.

SIGNAL CONDITIONING

25BP4 Signal conditioning accessory provides for 4 standard 5B-Series signal conditioning modules. Modules for thermocouples, RTDs, strain gauges, amplification and isolation are available.

Power source – 5 V, 1 A power is available in the 15-pin D-connector on the 25AA1 and 25AD3 acquisition cards.

POWER REQUIREMENTS

2505 Mainframe – 110 VAC to 220 VAC 50/60 Hz, 125 watts, max.

2510 Mainframe – 110 VAC to 220 VAC 50/60 Hz, 175 watts, max.

2520 Mainframe – 110 VAC to 220 VAC 50/60 Hz, 300 watts, max.

MECHANICAL & ENVIRONMENTAL

Temperature Range – Operating: 10°C to 40°C. Non-operating: –10°C to 50°C.

Relative Humidity – Up to 80% RH non-condensing.

PHYSICAL CHARACTERISTICS

	2505		2510S2		2520	
Dimensions	**mm**	**in**	**mm**	**in**	**mm**	**in**
Width	470	18.5	455	17.9	425	16.8
Height	225	8.85	203	8	260	10.25
Depth	502	19.75	432	17	600	23.5
Weight	**kg**	**lb**	**kg**	**lb**	**kg**	**lb**
Net	15.5	34	16.8	37	24.1	53

ORDERING INFORMATION

2505
Includes: One-slot mainframe with system software, built-in monochrome monitor, 40 Mb hard disk, parallel printer COMM Pack, soft sided case, and Operator's manual and detachable keyboard. Requires 1 acquisition card **$8,100**

2505S11 – 2505 with installed 4 CH 25AA1 Acquisition card **$9,975**

2505S13 – 2505 with installed 8 CH 25AD3 Acquisition card **$15,600**

2510S1
Two-slot mainframe
Includes: System software, color monitor, 40 Mb hard disk, parallel printer COMM Pack and Operator's manual. Requires 1 or 2 acquisition cards **$9,500**

2510S11 – 2510S1 with installed 4 CH 25AA1 Acquisition card **$12,900**

2510S12 – 2510S1 with installed 2 CH 25AA2 Acquisition card **$14,200**

2510S13 – 2510S1 with installed 8 CH 25AD3 Acquisition card **$17,000**

2510S2
Two-slot mainframe
Includes: System software, flat panel display, 40 Mb hard disk, parallel printer COMM Pack, soft sided case and Operator's manual. Requires 1 or 2 acquisition cards **$10,750**

2510S21 – 2510S2 with installed 4 CH 25AA1 Acquisition card **$14,150**

2510S22 – 2510S2 with installed 2 CH 25AA2 Acquisition card **$15,450**

2510S23 – 2510S2 with installed 8 CH 25AD3 Acquisition card **$18,250**

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

2500 Series TestLab

ORDERING INFORMATION

2520
TestLab Six-slot mainframe
Includes: system software, color monitor, 40 Mb hard disk, parallel printer COMM Pack, and Operator's manual.
Requires at least 1 acquisition card ..... **+$10,900**
Opt 03 – RS-232C Remote Control COMM Pack and manual ... **+$750**
Opt 10 – IEEE-488 (GPIB) COMM Pack and manual ..... **+$850**
Opt 15 – Add Color monitor for 2510S2X ..... **+$695**
Opt 22 – Substitute 80 Mb Hard Disk ..... **+$1,800**
Opt 88 – Factory Install Acquisition Cards ..... **NC**
NOTE: On orders with a mainframe and acquisition cards as separate line items, Opt. 88 designates the items to be built and tested as a system, not replacement parts.
Opt 94 – Cal Certificate, NIST ..... **NC**
Opt 95 – Cal Certificate & Test Results ..... **NC**
Opt 1R – 2520 Rack Mount Kit ..... **+$400**

INTERNATIONAL POWER PLUG OPTIONS
Opt. A1 – Universal Euro 220 V, 50 Hz ..... **NC**
Opt. A2 – United Kingdom 240 V, 50 Hz ..... **NC**
Opt. A3 – Australian 240 V, 50 Hz ..... **NC**
Opt. A4 – North American 240 V, 60 Hz ..... **NC**
Opt. A5 – Switzerland 220 V, 50 Hz ..... **NC**
See Customer Information Section for additional descriptions.

PLOTTER/PRINTER
Plotters – Centronix config. & cable. Order HC100 ..... **$1,075**
RS232C config. & cable. Order HC100 Opt. 03 ..... **$1,075**

ACQUISITION CARDS
25AA1 Four Differential Analog Channels
Includes: 100 KS/sec, 256 KS total memory, 12-bit vert res **$3,400**
25AA2 Two Single Ended Channels
Includes: 12.5 MS/sec, 64 KS/channel, 10-bit vert res **$4,700**
25AD3 8 Diff Analog Channels and 8 Digital Event Channels
Includes: 100 KS/sec/ CH, 64 KS/ CH, 12-bit vert res **$7,500**
Opt. 1D – Expand 25AD3 to 512 K Sample/ CH ..... **+$2,200**
Opt. 2D – Expand 25AD3 to 1 M Sample/ CH ..... **+$4,000**
25AD3F1 – Field Upgrade 25AD3 to 512 KS/ CH **$2,200**
25AD3F2 – Field Upgrade 25AD3 to 1 MS/ CH **$4,000**

Signal Conditioning –
25BP4 Four-slot Interface Backplane for 5B series signal conditioning modules. Use with 25AA1 & 25AD3 Acquisition cards **$285**

5B Series Module –
5B34-01 – 100 Ω Plat RTD in, –100° to 100°C, 0 to +5 VDC out. Order 119-3524-00 ..... **$150**
5B34-04 – 100 Ω Plat RTD input, 0° to 600°C, 0 to +5 VDC out. Order 119-3527-00 ..... **$150**
5B38-02 – Full Bridge Amplifier, 300 Ω to 10 KΩ input, (such as strain gages), –5 to +5 VDC output. Order 119-3533-00 ..... **$180**
5B40-01 – –10 mv to 10 mv input, –5 to +5 VDC output.. Order 119-3536-00 ..... **$150**
5B47-J-02 – J Type thermocouple input, –100° to 300°C, linearized, 0 to +5 VDC output. Order 119-3542-00 ..... **$205**
5B47-K-04 – K Type thermocouple input, 0° to 1000°C, linearized, 0 to +5 VDC output. Order 119-3543-00 ..... **$205**
AC1367 – One-to-one non-isolated voltage feedthrough, –10 VDC to +10 VDC maximum input and output. Order 119-3546-00 ..... **$39**
For additional signal conditioners see the 25BP4 data sheet or Burr Brown or Analog Devices catalogues.

WARRANTY-PLUS SERVICE PLANS OPTIONS
Opt. M7 – Calibration Service
2505 ..... **+$105**
2505S13 ..... **+$420**
2510S1 ..... **+$115**
2510S11 ..... **+$320**
2510S12 ..... **+$320**
2510S13 ..... **+$420**
2510S2 ..... **+$120**
2510S21 ..... **+$320**
2510S22 ..... **+$320**
2510S23 ..... **+$420**
2520 ..... **+$120**
25AA1 ..... **+$215**
25AA2 ..... **+$215**
25AD3 ..... **+$315**
Opt. M9 – Repair Protection
2505 ..... **+$425**
2505S13 ..... **+$820**
2510S1 ..... **+$475**
2510S11 ..... **+$705**
2510S12 ..... **+$720**
2510S13 ..... **+$820**
2510S2 ..... **+$495**
2510S21 ..... **+$705**
2510S22 ..... **+$720**
2510S23 ..... **+$820**
2520 ..... **+$570**
25AA1 ..... **+$280**
25AA2 ..... **+$295**
25AD3 ..... **+$395**

ADDITIONAL ACCESSORIES
Soft case – 2505 & 2510S1. Order 016-1095-00 ..... **$330**
Transit case – Wheels and hard side for 2505 & 2510S2. Order 016-0994-00 ..... **$715**
Color Monitor – Domestic. Order 119-4279-00 ..... **$635**
International. Order 119-4279-00 ..... **$635**
Flat Panel Display Upgrade – Order 30F0 ..... *2

Comm Packs –
RS-232 – Order 1200C01 ..... **$750**
GPIB – Order 1200C02 ..... **$850**
Parallel Printer – Order 1200C11 ..... **$500**

MANUALS
Operator's – Order 070-6921-02 ..... **$150**
Programmer's Reference – Order 070-7200-02 ..... **$55***1
MPU Board Service – Order 070-7413-01 ..... **$215**
25AA1 Acquisition Card Service – Order 070-7850-00 ..... **$125**
25AA2 Acquisition Card Service – Order 070-7851-00 ..... **$125**
25AD3 Acquisition Card Service – Order 070-8245-00 ..... **$125**
2505 Service*1 – Order 070-6676-00 ..... **$150**
2510 Service*1 – Order 070-7412-02 ..... **$175**

**1 A Mainframe Service Manual and an MPU Board Service Manual are needed for complete "Mainframe" service documentation. In addition, a manual for the installed acquisition card(s) is required for complete "system" service documentation.*
**2 Contact your local Tektronix representative for price information.*

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

Telecommunications

CONTENTS

Optical to Electrical Converters.....226, 232
SDH/SONET Reference Receivers.....228
Optical Converters/Power Meters 230
Optical Impulse Generators 234
Optical Attenuators 235
Optical Time Domain Reflectometers.....236, 241
Handheld Optical Fault Finder 238
Handheld Optical Power Meter 240
Subscriber Loop Portable Test Set 242
Metallic Cable Testers.....244
Pulse Template Tester 245
Communications Oscilloscopes.....246
Bit Error Rate Tester 254
Optical Communications Standards Test System.....265, 266

The Customers We Serve

Tektronix telecommunications test and measurement products principally serve two categories of customer, each having their own unique set of technical requirements and user needs.

The first group of customers are those involved in the research, development, design, and manufacturing of high speed communications equipment. You probably are already aware that Tektronix has been an industry leader for over forty years in providing state of the art test and measurement tools that can be trusted to provide reliable and accurate results. Tektronix products have proven their excellence in solving the toughest time domain waveform analysis and measurement problems for engineers involved in the research, design, and manufacture of communications equipment.

The second group of customers are primarily responsible for the installation, maintenance, and operation of telecommunications systems whose purpose is to provide either local area or long haul communication services. Tektronix has been a pioneer in the development of time domain reflectometry instrumentation for both metallic and fiber optic cable testing. Tektronix provides customers with both cable media testers as well as digital protocol and interface test instrumentation.

TIME DOMAIN WAVEFORM ANALYSIS, TEST, & MEASUREMENT

Tektronix is the world leader in providing high performance test and measurement tools for time domain waveform analysis, test, and measurement. Tektronix has consistently provided the industry performance standards to which others are compared.

The Tektronix Communications Signal Analyzer product line provides an unequaled capability to acquire, display, and measure repetitive telecommunications electrical and optical waveforms with timing resolution to intervals as small as 0.01 pico second and frequency bandwidths from DC to to 50 GHz. This product line is both modular and fully programmable. State of the art capabilities allow direct measurement of jitter and noise as well as automatic computation and live display of user specified data histograms. Waveform data is accumulated and stored in a powerful built-in statistical data base. The variable persistence full color display is used to view waveform eye diagrams, color graded statistical contours, user defined mask test regions, constellation diagrams, as well as the multiple waveform traces acquired and stored.

Telecommunications

BIT ERROR MEASUREMENT

The Tektronix Bit Error Rate Tester provides digital stimulus generation and error response measurements up to 700 MHz bit rates and 128K bit word lengths. These testers are compact portable units that are fully programmable and used to test the error performance of digital links and modules. Standard frame patterns for both Fiber Data Distributed Interface (FDDI) and Synchronous Optical Network (SONET) as well as Synchronous Digital Hierarchy (SDH) communications standards are provided. Support software for use on an IBM compatible personal computer is provided to allow easy creation, editing and down loading of custom test pattern sequences.

FIBER OPTIC COMPONENT & MODULE CHARACTERIZATION & TESTING

The Tektronix Opto-Electronic Product Line provides high fidelity optical to electrical conversion with instrument bandwidths ranging from DC-250 MHz up to DC-20 GHz. These optical converter units are packaged as modular front-ends for Tektronix' Communication Signal Analyzers and oscilloscopes, as well as compatible stand-alone instruments and modules. The OCP5000 Series products also provide an average reading optical power measurement capability.

When used in conjunction with the OIG500 Series Optical Impulse Generators as a stimulus source, the Tektronix Communication Signal Analyzers equipped with the appropriate optical to electrical converter, make a powerful measurement tool for such applications as high speed photo detector characterization, impulse response testing of fiber optic components, high resolution optical reflection measurements, and extremely accurate optical fiber length measurements.

COMMUNICATIONS CABLE TESTING

Time domain reflectometry measures and displays the condition of metallic and fiber optic cable media. Breaks and faults are accurately located and characterized.

Tektronix' metallic cable testers provide the ability to resolve multiple faults spaced as closely as 1.5 cm apart. Maximum measurement distances range out to 15 km. These testers are used in local area networks, telephone networks, cable TV, and power line testing. The higher resolution testers are also used in general manufacturing and quality control operations.

The new FiberMaster Optical Time Domain Reflectometer (OTDR) and Fiber Scout Optical Fault Finder are the leaders in a powerful new generation of OTDR instruments. The Tektronix OTDR product line offers distance resolution down to the order of centimeters, and maximum measurement ranges to over 100 km. These instruments are used in data communications networks, telephony networks, as well as cable TV distribution system installation and maintenance.

The new FiberChamp, Handheld Optical Power Meter provides the highest accuracy of any handheld optical power meter.

DIGITAL PROTOCOL & INTERFACE TESTING

Tektronix' new hand-held digital Interface and protocol test set for Integrated Services Digital Network (ISDN) compliant equipment is a unique and powerful tool for use by the crafts-level telephony service person. This small battery powered and highly rugged unit is an easy to use field tool.

OTHER SOLUTIONS FROM TEKTRONIX

Customers working with communications related equipment are served by many Tektronix products.

Television equipment users and broadcasters will find unique solutions responsive to their needs in Tektronix' TV Products Catalog.

Video signal transmission, distribution, and routing equipment users will find solutions for their applications in the catalogs of Tektronix' Grass Valley Group subsidiary.

Manufacturers and system testers having demanding data through-put requirements will find the VXI based automatic test equipment of Tektronix' Colorado Data Systems subsidiary to be particularly responsive to their needs.

And finally, if you have a need for general test and measurement equipment refer to this Tektronix General Product Catalog for information on a wide variety of instruments and accessories. Test and measurement tools such as general purpose spectrum analyzers, oscilloscopes, digital logic analyzers, pulse and function generators, as well as modular bench test instruments and power supplies will be found only in the Tektronix General Product Catalog.

P6701A
P6703A
P6711
P6713
P6721
P6751

Optical to Electrical Converters

The P6700 Series products, provide calibrated optical to electrical conversion in a compact and convenient package for use at commonly used optical communications wavelengths and modulation bandwidths.

P6701A
- 450 to 1050 nm
- DC to 700 MHz
- Si PIN

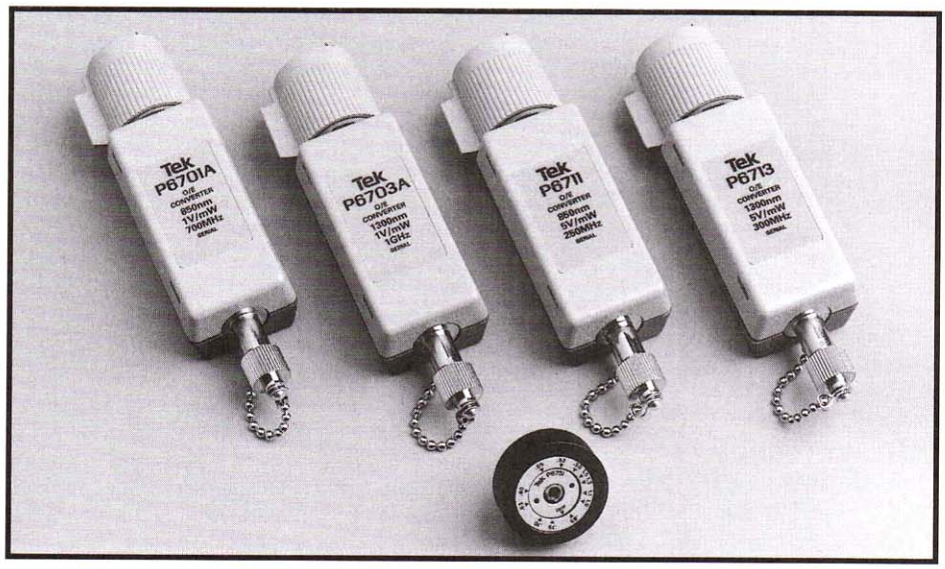
P6703A
- 1000 to 1700 nm
- DC to 1 GHz
- InGaAs PIN

P6711
- 450 to 1050 nm
- DC to 250 MHz
- High Gain
- Si PIN

P6713
- 1100 to 1700 nm
- DC to 300 MHz
- High Gain
- InGaAs PIN

P6721
- 450 to 1050 nm
- DC to 50 MHz
- Large Area Detector (3 mm)
- Si PIN

P6751 SPATIAL INPUT HEAD
- 500 to 1500 nm
- Tuneable



P6701A, P6703A, P6711, P6713 and Optical to Electrical Converters and P6751 Spatial Input Head.

Product Description

The Tektronix P6701A/P6703A/P6711/P6713 are optical probes that allow the user to receive optical signals and convert them to electrical signals for convenient analysis on Tektronix oscilloscopes equipped with the TEKPROBE™ Interface or any other oscilloscope when used in conjunction with the Tektronix 1103 TEKPROBE™ Interface Power Supply.

Use of the 11000 Series oscilloscope's TEKPROBE™ Interface allows the oscilloscope to supply power to the P6700 Series probes, automatically determine and display the proper scale factor (in microwatts of optical power) and set the input termination to the required 50 Ω.

The P6700 Series provides a calibrated means of analog analysis of optical signals in the wavelength range 450 to 1050 nm (P6701A/P6711) and 1100 to 1700 nm (P6703A/P6713). Thus the functions of an optical power meter and the high-speed analog waveform analysis capability of an oscilloscope are combined in one instrument. The user has the capability of acquiring, displaying and analyzing mixed analog and digital, optical and electrical signals simultaneously.

The P6701A and P6703A have an added DC stable circuit from decreased offset drift (≤1 μW). This improves the performance for extinction ratio measurements and absolute optical power levels. The P6711 and P6713 have increased gain and lower noise, thus have improved the sensitivity of the converters and are excellent choices for LED measurements.

P6721

The P6721 is a high gain optical to electrical converter for use with plastic fiber and larger diameter glass fiber. For the laser disk service, automotive optical communication and others, the P6721 is a link to waveform test and measurement tools. The P6721 uses Tektronix probe power or the 1101A Power Supply.

The P6751 Spatial Input Head is a tunable lens system for sampling optical energy from any collimated source and delivering it via a fiber optic cable to the P6700 Series Optical to Electrical Converter. The P6751 is easily mounted using standard optical bench fixtures. This spatial input head can be adjusted (500 to 1500 nm) by the user to optimize the amount of optical energy delivered to the P6700 Series. The P6751 has a standard SMA fiber optic cable connector. The P6751 is intended for use with 100/140 μm diameter multimode fiber.

Also available are a series of fiber optic jumper cables for interfacing the P6700 Series and P6751 with other industry standard optical fiber connectors.

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

Optical to Electrical Converters

P6701A	P6713
P6703A	P6721
P6711	P6751

TYPICAL APPLICATIONS
Applications range from measuring the transient optical properties of lasers, LEDs, electro-optic modulators, flashlamps, etc., to the development, manufacturing, and maintenance of fiber optic control networks, local area networks (LANs), fiber based systems based on the FDDI and SONET standard, optical disk devices, and high-speed fiber optic communications systems. As an example, eight probes of the P6700 Series type coupled with two 11A34 Amplifier Plug-ins and an 11000 Series oscilloscope can be configured as an 8-channel optical oscilloscope.

Characteristics

	P6701A	P6703A	P6711	P6713	P6721
Wavelength Response	500 to 950 nm	1100 to 1700 nm	500 to 950 nm	1100 to 1700 nm	400 to 1000 nm
Bandwidth	DC to 850 MHz	DC to 1 GHz	DC to 250 MHz	DC to 300 MHz	DC to 50 MHz
Rise time	≤700 ps	≤500 ps	≤2 ns	≤1.6 ns	≤10 ns
Conversion Gain	1 V/mW at 850 nm	1 V/mW at 1300 nm	5 V/mW at 850 nm	5 V/mW at 1300 nm	10 V/mW at 660 nm
Max Input Optical Power	1 mW	1 mW	200 µW	200 µW	0.3 mW
Noise Equivalent Power	≤1 µW(rms)	≤1 µW(rms)	≤250 nW(rms)	≤200 nW (rms)	≤200 nW(rms)
Max. Input Fiber Core Diameter	200 µm	100 µm	200 µm	100 µm	1000 µm

Note: For further technical information on these above products request the following product literature:
- *For P6701A, P6711, P6703A, P6713 – #3TW-7914 (Data Sheet).*
- *For P6721 – #3TW-8309-0 (Data Sheet).*
- *For P6751 – #3TW-7304-1 (Data Sheet/Application Note).*

ORDERING INFORMATION

P6701A
Optical-to-Electrical Converter ..... **NC**
Includes: Option specified fiber optic input connector, carrying case (016-0156-03), and Instruction Manual (070-8237-00).
Opt. 01 – FC input connector ..... **+$2,625**
Opt. 02 – ST* input connector ..... **+$2,625**
Opt. 03 – DIN 47256 input connector ..... **+$2,625**
Opt. 04 – SMA input connector ..... **+$2,625**
Opt. 05 – SC input connector ..... **+$2,625**

P6703A
Optical-to-Electrical Converter ..... **NC**
Includes: Option specified fiber optic input connector, carrying case (016-0156-03), and Instruction Manual (070-8237-00).
Opt. 01 – FC input connector ..... **+$3,605**
Opt. 02 – ST* input connector ..... **+$3,605**
Opt. 03 – DIN 47256 connector ..... **+$3,605**
Opt. 04 – SMA input connector ..... **+$3,605**
Opt. 05 – SC input connector ..... **+$3,605**

P6711
Optical-to-Electrical Converter ..... **NC**
Includes: Option specified fiber optic input connector, carrying case (016-0156-03), and Instruction Manual (070-8237-00).
Opt. 01 – FC input connector ..... **+$2,100**
Opt. 02 – ST* input connector ..... **+$2,100**
Opt. 03 – DIN 47256 connector ..... **+$2,100**
Opt. 04 – SMA input connector ..... **+$2,100**
Opt. 05 – SC input connector ..... **+$2,100**

P6713
Optical-to-Electrical Converter ..... **NC**
Includes: Option specified fiber optic input connector, carrying case (016-0156-03), and Instruction Manual (070-8237-00).
Opt. 01 – FC input connector ..... **+$2,500**
Opt. 02 – ST* input connector ..... **+$2,500**
Opt. 03 – DIN 47256 connector ..... **+$2,500**
Opt. 04 – SMA input connector ..... **+$2,500**
Opt. 05 – SC input connector ..... **+$2,500**

P6721
Optical to Electrical Converter **$1,450**
Includes: Standard TOSLINK fiber optic input Connector, and Instruction Manual (070-7842-00).

P6751
Spatial Input Head **$445**
Includes: Adjustment tool and instruction sheet.

OPTIONAL ACCESSORIES
TEKPROBE Power Supply – Order 1103 ..... **$495**

Fiber Optic Cables – Single Mode and Multimode
The following fiber optic cable assemblies are intended to provide high quality interconnections between fiber optic test equipment having the same or different optical connector types. Each cable assembly consists of a single jacketed fiber connectorized on both ends with male connectors. Cables with different type connectors on each end are for interconnecting two instruments having dissimilar female connectors. The type of connector installed on each end of the fibers are indicated below.

Single Mode
Fiber Optic Cables – 2 meter length, 8/125 µm core/cladding diameter, including in-line connector adapter.
FC/PC to Diamond 3.5 connectors. Order 174-1385-00 ..... **$605**
FC/PC to ST* connectors. Order 174-1386-00 ..... **$770**
FC/PC to FC/PC connectors. Order 174-1387-00 ..... **$440**
FC/PC to Biconic connectors. Order 174-1388-00 ..... **$550**
FC/PC to Diamond 2.5 connectors. Order 174-1497-00 ..... **$580**

Multimode
Fiber Optic Cables – 2 meter length, 62.5/125 µm core/cladding diameter.
FC/PC to FC/PC connectors. Order 174-2322-00 ..... **$175**
FC/PC to Biconic connectors. Order 174-2323-00 ..... **$250**
FC/PC to SMA connectors. Order 174-2324-00 ..... **$175**
Fiber Optic Cables – 2 meter length, 100/140 µm core/cladding diameter.
SMA to ST* connectors. Order 174-0876-00 ..... **$320**
SMA to Diamond 3.5 connectors. Order 174-0877-00 ..... **$350**
SMA to FC connectors. Order 174-0878-00 ..... **$370**
SMA to SMA connectors. Order 174-0879-00 ..... **$370**
SMA to Biconic connectors. Order 174-0880-00 ..... **$260**
SMA to Diamond 2.5 connectors. Order 174-1303-00 ..... **$300**

**ST is a registered trademark of AT&T*

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

ORS52
ORS156
ORS622

SDH/SONET Reference Receivers

The ORS Series of SDH/SONET Reference Receivers provides calibrated testing to ensure optical transmitter compliance with SDH/SONET OC-1, OC-3/STM-1, and OC-12/STM-4 frequency-response specifications.

ORS52/ORS156/ ORS622

- Individually Matched Filter/Converter Sets
- Verified and Documented SDH/SONET Frequency-Response
- OC-1, OC-3/STM-1, and OC-12/STM-4 Bit Rates
- Wide Selection of Filter/Converter Combinations
- FC, ST, DIN 47256, SMA, and SC Optical Input Connectors Available
- TEKPROBE Interface Compatible
- GPIB 488.2 Controllable Versions Available

NEW ORS52, ORS156, ORS622

Verifying SDH/SONET System Performance

The Synchronous Data Hierarchy (SDH) and the Synchronous Optical NETwork (SONET) standards are crucial to the next generation of high speed digital telecommunications systems. The SONET Standard is observed in North America and the SDH Standard is dominant in Europe, Japan, and elsewhere. The Tektronix ORS Series of optical reference receivers fills a crucial test system gap for verifying SDH/SONET optical system performance.

These are true optical receivers, not just filters. The O/E converter and filter in each ORS Series receiver is matched to a specific SDH/SONET bit rate and is rigorously calibrated to ensure strict compliance with the SDH/SONET fourth-order Bessel-Thomson frequency response required of SDH/SONET reference receivers.

The result is a precision optical reference receiver that can be relied upon to faithfully represent transmitted signals at specific SDH/SONET bit rates for the purpose of waveform or eye pattern analysis. Without an optical reference receiver of this completeness and precision, optical transmitter signal evaluation can become fraught with uncertainties caused by unrelated optical transmitter noise.

In addition to defining optical system signal hierarchy and signal characteristics, SDH/SONET also defines test methodologies and specifications for verifying equipment and system performance. Prominent in this is the use of an SDH/SONET optical reference receiver and an oscilloscope for display and comparison of the data eye-pattern to specified masks.

ORS SERIES SPECIFICATIONS

SDH/SONET recommendations define the nominal transfer function for an optical reference receiver as being a fourth-order Bessel-Thomson response. The following table lists the corresponding attenuation at various frequencies, f. In this table f_o is the receiver's bit rate and f_r is the 3-dB cutoff, which is defined as $f_r=0.75f_o$.

NOMINAL PERFORMANCE VALUES FOR AN SDH/SONET OPTICAL REFERENCE RECEIVER

(O/E Converter and Filter Together)

f/f_o	f/f_r	Attenuation (dB)
0.15	0.2	0.1
0.3	0.4	0.4
0.45	0.6	1.0
0.6	0.8	1.9
0.75	1.0	3.0
0.9	1.2	4.5
1.0	1.33	5.7
1.05	1.4	6.4
1.2	1.6	8.5
1.35	1.8	10.9
1.5	2.0	13.4
2.0	2.67	21.5

Allowable deviation from the nominal attenuation in the table is very tightly specified in the SDH/SONET recommendations. The actual allowable deviation values depend on f/fr and the bit rate. However, as of this printing, the provisional values run as low as ±0.3 dB.

Each Tektronix ORS Series SDH/SONET Reference Receiver is a matched O/E converter and filter set. Selection is based on extensive frequency-response testing, and all verification tests are documented. The verification document is supplied as part of the ORS Series SDH/SONET Reference Receiver. This document contains the serial numbers of the O/E converter and filter that make up the receiver as well as the measured verification data for that receiver.

The end result is that each Tektronix ORS Series SDH/SONET Reference Receiver is an individually calibrated product. This allows accurate measurements to be made when testing for SDH/SONET standards compliance.

The Tektronix ORS SDH/SONET Reference Receiver family covers the OC-1, OC-3/STM-1, and OC-12/STM-4 bit rates. Various receiver options can also be ordered depending on the receiver gain, price range, and optical input connector desired. Options providing FC, ST, DIN 47256, SMA, and SC optical connector inputs are available.

Receiver selection is based, first of all, on the SDH/SONET bit rate of interest. For greatest flexibility, a receiver based on the OCP5502 O/E converter is recommended even for OC-1 applications. The broad bandwidth of the OCP5502 allows later addition of filters to cover higher bit rates as needed without having to purchase an additional O/E converter. For OC-1 applications requiring economy and high sensitivity, but not requiring flexibility for higher bit rates, a receiver based on the P6713 O/E Converter is recommended. Where economy or coverage of more than one bit rate is the greatest concern,

Continued on next page.

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

GPIB IEEE-488 — The SDH/SONET Reference Receivers comply with IEEE Standard 488.1-1987, and with Tektronix Standard Codes and Formats.

SDH/SONET Reference Receivers

ORS52
ORS156
ORS622

receivers based on the P6703A O/E converter are the appropriate choice for testing OC-1 and OC-3/STM-1 bit rates. These receivers use one of three filters – FS52, FS156, or FS622 – for each of the three different bit rates. The ORS Series SDH/SONET Reference Receivers are TEKPROBE™ compatible. When used with Tektronix oscilloscopes having the TEKPROBE interface, screen displays will show the proper scale factor for the optical signal (microwatts of optical power). This allows direct measurement and display of results without having to manually apply conversion factors. For oscilloscopes or other instruments not having this TEKPROBE interface, a Tektronix 1103 Power Supply can be ordered separately for ORS Series Reference Receivers using P6703A or P6713 O/E Converters. ORS Series Reference Receivers using the OCP5502 O/E Converter are compatible with, but do not require the TEKPROBE Interface for their operation.

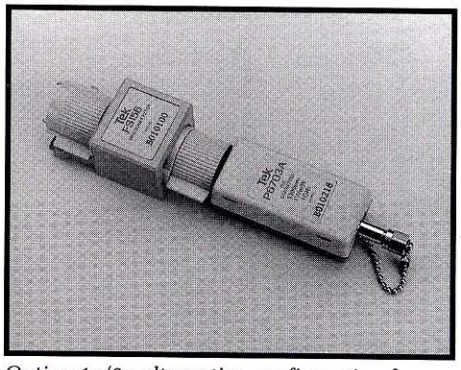
SELECTION TABLES

Receiver	Option	Configuration	Optical Connectors	Key Benefits
OC-1 (51.84 MBits/Sec)				
ORS52		OCP5502/FS52 & OC-1 Calibration	FC, ST, DIN 47256, and SC	Greatest flexibility. Can add filters for OC-3 and OC-12. Built-in power meter. GPIB.
	1x*	P6703A/FS52 & OC-1 Calibration	*	Greatest value. Can add filter for OC-3.
	2x*	P6713/FS52 & OC-1 Calibration	*	Highest sensitivity.
OC-3/STM-1 (155.52 MBits/Sec)				
ORS156		OCP5502/FS156 & OC-3 Calibration	FC,ST, DIN 47256, and SC	Greatest flexibility. Can add filters for OC-1 and OC-12. Built-in power meter. GPIB.
	1x*	P6703A/FS156 & OC-3 Calibration	*	Greatest value. Can add filter for OC-1.
	31	Add FS52 & OC-1 Calibration		
OC-12/STM-4 (622.08 MBits/Sec)				
ORS622		OCP5502/FS622 & OC-12 Calibration	FC, ST, DIN 47256, and SC	Greatest flexibility, Built-in power meter. GPIB. Multiple bit rate options.
	31	Add FS52 & OC-1 Calibration		
	41	Add FS156 & OC-3 Calibration		

**x=1 (FC Optical Input Connector). x=2 (ST Optical Input Connector). x=3 (DIN 47256 Optical Input Connector). x=4 (SMA Optical Input Connector). x=5 (SC Optical Input Connector).*

Note: [a]For further technical information on ORS Series products request Data Sheet #3TW-8530-0.

[b]For information on SDH/SONET Reference Receiver calibration services available for new or previously purchased O/E Converters, contact your local Tektronix sales office.



Option 1x/2x alternative configuration for ORS52 or ORS156.

ORDERING INFORMATION

ORS52
SDH/SONET Receiver **$11,295**
Includes: OCP5502, FS52 Filter, Calibration Document (062-1266-00), Instruction Manuals (070-8562-00).

Opt. 11 – Delete OCP5502/Add P6703A Opt. 01 – FC Optical Input Connector ..... **–$6,300**

Opt. 12 – Delete OCP5502/Add P6703A Opt. 02 – ST Optical Input Connector ..... **–$6,300**

Opt. 13 – Delete OCP5502/Add P6703A Opt. 03 – DIN 47256 Optical Input Connector ..... **–$6,300**

Opt. 14 – Delete OCP5502/Add P6703A Opt. 04 – SMA Optical Input Connector ..... **–$6,300**

Opt. 15 – Delete OCP5502/Add P6703A Opt. 05 – SC Optical Input Connector ..... **–$6,300**

Opt. 21 – Delete OCP5502/Add P6713A Opt. 01 – FC Optical Input Connector ..... **–$7,300**

Opt. 22 – Delete OCP5502/Add P6713A Opt. 02 – ST Optical Input Connector ..... **–$7,300**

Opt. 23 – Delete OCP5502/Add P6713A Opt. 03 – DIN 47256 Optical Input Connector ..... **–$7,300**

Opt. 24 – Delete OCP5502/Add P6713A Opt. 04 – SMA Optical Input Connector ..... **–$7,300**

Opt. 25 – Delete OCP5502/Add P6713A Opt. 05 – SC Optical Input Connector ..... **–$7,300**

ORS156
SDH/SONET Receiver **$11,395**
Includes: OCP5502, FS156 Filter, Calibration Document (063-1266-00), Instruction Manuals (070-8562-00).

Opt. 11 – Delete OCP5502/Add P6703A Opt. 01 – FC Optical Input Connector ..... **–$6,300**

Opt. 12 – Delete OCP5502/Add P6703A Opt. 02 – ST Optical Input Connector ..... **–$6,300**

Opt. 13 – Delete OCP5502/Add P6703A Opt. 03 – DIN 47256 Optical Input Connector ..... **–$6,300**

Opt. 14 – Delete OCP5502/Add P6703A Opt. 04 – SMA Optical Input Connector ..... **–$6,300**

Opt. 15 – Delete OCP5502/Add P6703A Opt. 05 – SC Optical Input Connector ..... **–$6,300**

Opt. 31 – Add FS52 Filter and OC-1 Calibration ..... **+$1,500**

ORS622
SDH/SONET Receiver **$11,495**
Includes: OCP5502, FS622 Filter, Calibration Document (063-1266-00), Instruction Manuals (070-8562-00).

Opt. 31 – Add FS52 Filter and OC-1 Calibration ..... **+$1,500**

Opt. 41 – Add FS156 Filter and OC-3/STM-1 Calibration ..... **+$1,600**

ADDITIONAL ACCESSORIES
Fiber Optic Cables – Refer to Page 227 for complete list.
TEKPROBE™ Interface Cable – Order 012-1372-00 ..... **$350**
TEKPROBE™ Power Supply – Order 1103 ..... **$495**

NOTE: for use with oscilloscopes or other signal analysis instruments not having Tektronix TEKPROBE Interface compatibility, the ORS52 and ORS156 reference receivers using the P6703A or P6713 O/E Converters require a Tektronix 1103 Power Supply to be ordered separately.

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

OCP 5002
OCP 5502

Optical to Electrical Converters/Power Meters

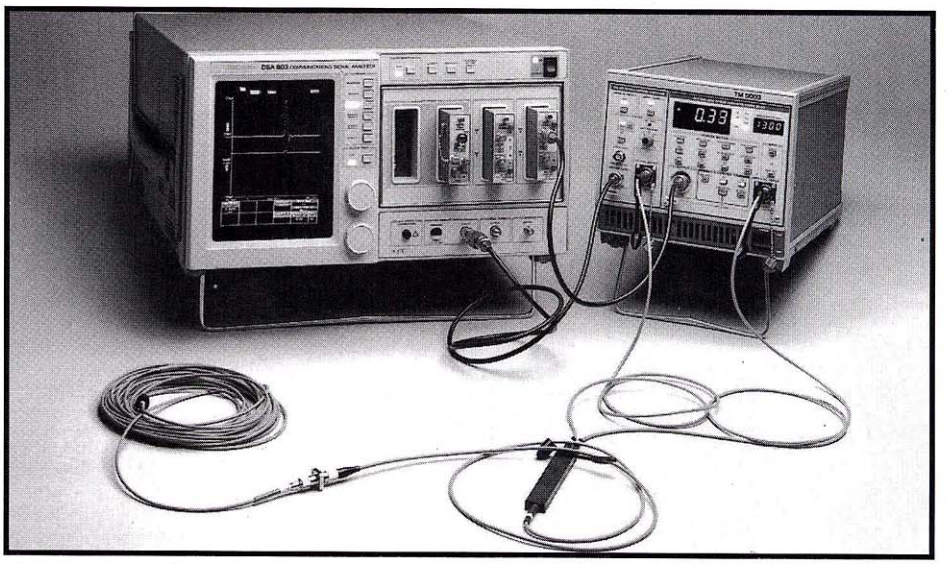
The OCP 5000 Series products provide general purpose optical to electrical conversion and simultaneous measurement and display of average optical power over a wide signal bandwidth.

OCP 5002/OCP 5502

- DC to 2 GHz Optical to Electrical Conversion
- Extremely Low Drift
- Low Equivalent Input Noise
- High Optical Return Loss
- Average Reading Optical Power Meter
- GPIB IEEE 488.2 Controllable
- TEKPROBE Interface compatible
- Multiple Optical Connector Types Accommodated
  - –FC/PC
  - –DIN 47256
  - –ST*
  - –SC

APPLICATIONS

- Accurate Extinction Ratio Measurements
- Optical Eye-pattern Analysis
- LED and Laser Transmitter Characterization
- FDDI and SONET Waveform Standards Verification
- High Sensitivity Optical Reflection Measurements
- High Resolution Optical Reflectometry
- Optical Digital Communication Measurements
- Optical Component Characterization



High Resolution Optical Reflection Measurement using OIG 502, OCP 5502 and the CSA 803.

OCP 5002/OCP 5502

The OCP 5000 Series instruments are optical to electrical converters with an average reading optical power meter integrated into their design. This combination eliminates the need to use two separate instruments to make parametric measurements on optical signals.

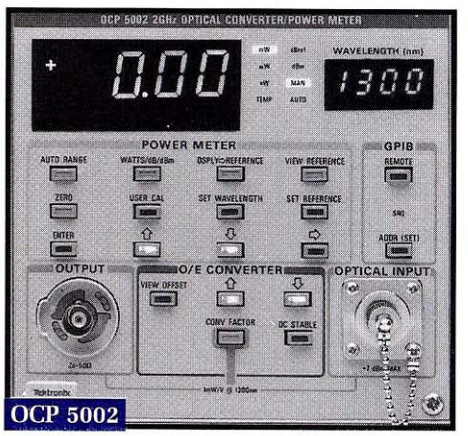
The OCP 5002 occupies two slots in a Tektronix TM 5000 Series Modular Instrument Mainframe. The OCP 5502 is a functionally equivalent instrument, packaged as a stand-alone, monolithic unit. The OCP 5000 Series instruments can be operated from the front panel keypad or from a GPIB controller. The GPIB interface meets the IEEE 488.2 standard. The front panel controls are all matched over the bus and all readings can be communicated over the GPIB interface.

The power meter displays average optical power input in Watts, dBm and dB. You can set the calibration level to a user defined wavelength (within the 1100 to 1650 nm range) with a simple button push or GPIB command. This feature allows you to use the OCP 5000 Series instruments to design tests and applications that meet your specifications.

In addition to operating with any Tektronix oscilloscope, OCP 5000 Series instruments offer additional functionality when connected with instruments that have a TEKPROBE™ interface. With the optional TEKPROBE cable, users can read the optical power units directly on the oscilloscope screen.

The Tektronix OCP 5000 Series instruments in the standard configuration are shipped with the "FC" Style optical connector on the input. They are also shipped with field installable front panel connectors to change the input to either "ST*," "SC," or "DIN 47256" style connectors. Changing the input connectors is simple and the manual includes clear instructions on how to make this change whenever needed.

**ST is a registered trademark of AT&T.*



OCP 5002

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

GPIB IEEE-488 — The OCP 5002/ OCP 5502 comply with IEEE Standard 488.1-1987, and with Tektronix Standard Codes and Formats.

Optical to Electrical Converters/Power Meters

OCP 5002
OCP 5502

OPTICAL REFLECTION TESTS

Optical reflections in fiber optic systems can seriously degrade transmission performance, especially in high-speed communications links using laser sources. Characterization of the reflective performance of optical connectors and components can be crucial to ensuring signal integrity in fiber optic communications equipment.

The OCP 5000 Series instruments can be used with the Tektronix CSA 803, CSA 404 Communication Signal Analyzers or other 11000 Series oscilloscopes and the OIG 502 Optical Impulse Generator to evaluate optical reflections. The return loss of optical reflections can be measured to levels ≤50 dB. Depending on the specific instrument configuration used, multiple reflection events in optical fiber can be spatially resolved to the centimeter range. Single reflection events in optical fiber can be measured down to sub-millimeter accuracy levels.

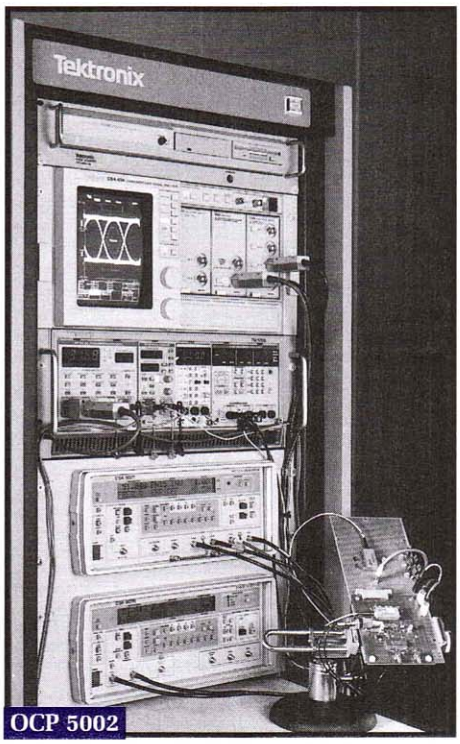
OPTICAL DIGITAL COMMUNICATION TESTS

The OCP 5000 Series instruments, with their 2 GHz bandwidth, are excellent optical to electrical converters for use in FDDI and SONET compliance testing. When combined with other Tektronix instruments, the OCP 5000 instruments can be used for mask test verification to the FDDI and SONET waveform standards.

The OCP 5000 Series instruments when coupled with the Tektronix CSA 803 or CSA 404 Communication Signal Analyzers can perform on-board optical eye pattern analysis even at the low signal levels characteristic of LED transmitters.

When the OCP 5000 Series instruments are coupled with the CSA 404 or other Tektronix 11000 Series oscilloscopes equipped with the TEKPROBE interface, users can evaluate complex time-domain optical signals to determine the physical layer performance of a fiber optic communication network. Accurate extinction ratio measurements are made possible by the low (<0.5 μW) DC drift of the optical to electrical converter when the instrument is in the DC Stable Mode.

The OCP5000 Series instruments are used as one of the base optical to electrical converters in the Tektronix ORS Series SDH/SONET Reference Receivers. For further information on these Reference Receiver consult the separate entry on these products appearing in this catalog.



OCP 5002

Tektronix Physical Layer Standards Compliance Test System for testing to high speed digital communications standards such as FDDI and SDH/SONET. OCP 5002 shown in TM5006 Modular Instrument Mainframe.

OPTICAL COMPONENT CHARACTERIZATION

The combination of an average reading optical power meter and a 2 GHz optical to electrical converter in one instrument, provides unique benefits when either manual or program control modes are being used. This combination allows users to fulfill most of their optical component characterization requirements with a single instrument. It also allows different tests and multiple test steps to be run without disconnecting and reconnecting optical fiber connectors. This reduces both testing time and cost as well as increases measurement reliability and repeatability.

The OCP 5000 Series instruments meet or exceed performance specifications for characterizing many of the latest fiber optic components, such as lasers and LEDs.

Characteristics

Optical Converter	OCP 5002/OCP 5502
Wavelength Response	1100-1650 nm
Bandwidth	DC-2 GHz*1
Risetime	260 ps
Conversion Gain	1 V/mW ±8% at 1300 nm
Calibrated Offset	0-1 mW ±1%
Maximum Input Optical Power	2 mW offset at 1 mW 1 mW (no offset)
Noise Equivalent Power	≤1 μW rms
Optical Power Meter	
Dynamic Range	+7 dBm to –80 dBm
Accuracy*2	≤5% at 1300 nm

**1 –3 dB Optical/–6 dB Electrical*
**2 With FC/PC Connectors*

Note: For further technical information on the OCP 5000 Series products request Data Sheet #3TW-7671-1.

ORDERING INFORMATION

OCP 5002
2 GHz Optical Converter/Power Meter **$8,950**
Includes: Instruction manual (070-7817-00).

OCP 5502
2 GHz Optical Converter/Power Meter **$9,950**
Includes: Instruction manual (070-7817-00).

OPTIONAL ACCESSORIES
Fiber Optic Cables – Refer to page 227 for complete list.
TEKPROBE™ Interface Cable – Order 012-1372-00 ..... **$330**

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

SA-42 SA-46

SD-42 SD-46

Optical to Electrical Converters

The SD and SA Series products are general purpose optical to electrical converters for use with oscilloscopes and spectrum analyzers.

SD-42
- 55 ps Optical Impulse Response
- DC – 6.4 GHz Optical Bandwidth
- 1000 nm – 1700 nm Spectral Response
- Mean Optical Power Monitor Function

SD-46
- 22 ps Optical Impulse Response
- DC – 20 GHz Optical Bandwidth
- 1200 nm – 1650 nm Spectral Response
- Mean Optical Power Monitor Function

SA-42
- 50 ps Optical Impulse Response
- DC – 7 GHz (–3 dB), to 15 GHz (–25 dB)
- 1000 nm – 1700 nm Spectral Response
- Ultra Low Noise

SA-46
- 22 ps Optical Impulse Response
- DC-20 GHz Optical Bandwidth
- 1100 nm to 1650 nm Spectral Response

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

Optical to Electrical Converter Plug-In Head

Optical to Electrical Converter Module

SD-42

The SD-42 is an optical to electrical converter for use with the Tektronix CSA800 or 11800 Series sampling oscilloscopes equipped with an SD-22, SD-24, or SD-26 Sampling Head. The optical to electrical conversion is linear up to 25 mW peak input with a calibrated deflection factor from 50 µW/div to 5 mW/div for optical wavelengths at 1300 nm. This unit has a 55 ps optical impulse response (max. FWHM) with the SD-24 and SD-26 Sampling Heads and 60 ps optical impulse response (max. FWHM) with the SD-22 Sampling Head.

SD-46

The SD-46 is an optical to electrical converter plug-in head for use with the Tektronix CSA800 or 11800 Series sampling oscilloscopes equipped with an SD-22, SD-24, or SD-26 Sampling Head. The optical to electrical conversion is linear up to 25 mW peak input with a calibrated deflection factor from 60 µW/div to 6 mW/div for optical wavelengths at 1300 nm. This unit has a 28.5 ps optical impulse response (max. FWHM) with the SD-24 and SD-26 Sampling Heads.

The SD-42 and the SD-46 Optical to Electrical Converters can be plugged into the sampling unit or attached by a sampling head extender for remote use. The head extenders come in either 1 meter (012-1220-00) or 2 meter (012-1221-00) options. Refer to next page for SD-42 and SD-46 head extenders.

Optical signal input on the SD-42, SD-46, SA-42, and SA-46 are through a standard FC fiber optic connector. Other connector types can be accommodated by using fiber optic jumper cables offered by Tektronix. The SD-42 and the SD-46 also have a mean power meter function with selectable 1 V/nW and 1 V/µW ranges.

STAND-ALONE CONVERTER MODULES

The SA-46 and SA-42 are stand-alone, wide-bandwidth optical-to-electrical converters packaged as small (palm sized) compact modules that are easy to use.

The SA-42 and SA-46 Optical-to-Electrical Converters can be used with Tektronix oscilloscopes and spectrum analyzers, as well as other manufacturers' instruments. These wide-bandwidth optical converters support the analysis of the frequency and time domain characteristics of lightwave modulation in optical fiber based equipment and communications systems.

The SA-42 and SA-46 have an internal battery power source that can be recharged via the battery charger. The SA-42 and SA-46 units have integral battery test indicators to monitor battery status. The units have an FC optical fiber input connector and a female "K" electrical output connector.

TYPICAL APPLICATIONS

Characterization of opto-electronic devices such as laser diodes, light emitting diodes, optical waveguides, optical detectors and electro-optic modulators is becoming more important as applications for fiber optics in telecommunications and data communications expand. The SD-42 and the SA-42 Optical to Electrical Converters offer DC to 7 GHz bandwidth performance for wavelengths from 1000 nm to 1700 nm. The SD-42 and SD-46 Optical to Electrical Converters give fiber optic equipment developers and researchers optical waveform measurement capability from DC to 20 GHz in the 1200 nm to 1650 nm wavelength range. Measurements such as risetime, aberration, optical power vs drive current and voltage, modulation bandwidth, and sensitivity can now be made at high bandwidth, accurately and easily.

The SA-42 or SA-46, combined with a Tektronix oscilloscope or spectrum analyzer, provides convenient optical waveform analysis capabilities. This is useful in the development and characterization of optoelectronic components and modules found in fiber optic transmission networks and fiber optic sensor systems.

Optical to Electrical Converters

SA-42 **SD-42**
SA-46 **SD-46**

Characteristics

PULSE CHARACTERISTICS

	SD-42	SD-46	SA-42	SA-46
Impulse Response	55 ps Max. (FWHM)	22 ps(FWHM)*1	50 ps Max (FWHM)	22 ps Max (FWHM)
Bandwidth	DC–6.4 GHz Optical	DC–20.0 GHz Optical	DC–7.0 GHz Optical	DC–20.0 GHz Optical
Spectral Response	1000 to 1700 nm	1200 to 1650 nm	1000 to 1700 nm	1100 to 1650 nm
Noise Equivalent Power	< 23 pW/$\sqrt{Hz}$*2 ≤33 μW*3 ≤10 μW*4	≤ 32 pW/$\sqrt{Hz}$*2 ≤45 μW*3 ≤16 μW*4	23 pW/$\sqrt{Hz}$*2	≤ 32 pW/$\sqrt{Hz}$*2 ≤45 μW*3 ≤16 μW*4
Linear Response Range	≤25 mW Peak Power ≤5 mW Average Power	≤25 mW Peak Power ≤5 mW Average Power	≤25 mW Peak Power ≤5 mW Average Power	≤25 mW Peak Power ≤5 mW Average Power
Aberrations	≤15% p-p*5	≤10% p-p*5	≤15% p-p*5	≤10% p-p*5
Conversion Gain	40 mV/mW	29 mV/mW	40 mV/mW	29 mV/mW
Conversion Factor	25 μW/mV	35 μW/mV	25 μW/mV	35 μW/mV

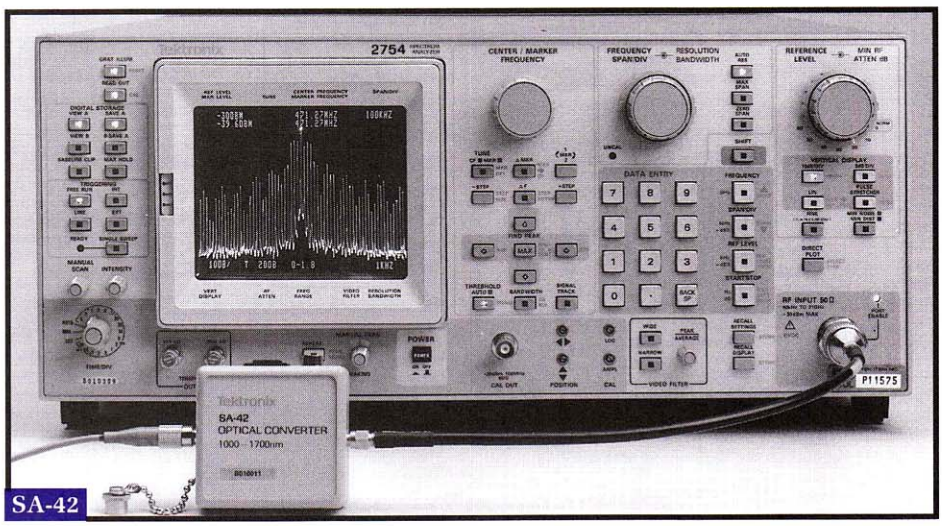
MEAN OPTICAL POWER MONITOR

	SD-42	SD-46	SA-42	SA-46
Dynamic Range	5 nW to 5 mW (60 dB)	5 nW to 5 mW (60 dB)	NA	NA
Sensitivity Range 1	1 V/mW ±10%	1 V/mW ±10%	NA	NA
Sensitivity Range 2	1 V/μW ±10%	1 V/μW ±10%		

**1 Calculated (.44/Optical Bandwidth).*
**2 Root Hertz Into 50 Ω.*
**3 System specification with SD-24/SD-26.*
**4 System specification with SD-22.*
**5 Within the first 400 ps following a pulse input.*

ENVIRONMENTAL

Operating Temperature Range – 0°C to 50°C.



SA-42 Optical to Electrical Converter with Tektronix 2754 Spectrum Analyzer.

ORDERING INFORMATION

SD-42
Optical to Electrical Converter **$3,995**
Includes: Red, 2 mm to banana lead, 1 m length (012-1286-00), black, 2 mm to banana lead, 1 m length (012-1287-00), 50 Ω semi-rigid cable link (174-1635-00), Instruction Manual (070-8671-00)

SD-46
Optical to Electrical Converter **$6,995**
Includes: Red, 2 mm to banana lead, 1 m length (012-1286-00), black, 2 mm to banana lead, 1 m length (012-1287-00), 50 Ω semi-rigid cable link (174-1635-00), Instruction Manual (070-8671-00).

SA-42
Optical to Electrical Converter **$3,995**
Includes: Instruction Manual (070-7733-00), Power Supply and Charger Unit (119-3716-00), DC Power Cable (174-1966-00), and Power Cable (161-0104-00).

SA-46
Optical to Electrical Converter **$6,995**
Includes: Instruction Manual (070-8047-00), Power Supply and Charger Unit (119-3716-00), DC Power Cable (174-1956-00), and Power Cable (161-0104-00).

OPTIONAL ACCESSORIES
Fiber Optic Cables – Refer to Page 227 for complete list.

OTHER ACCESSORIES
Sampling Head Extender Cables –
(1 m). Order 012-1220-00 (SD-42 and SD-46) **$710**
(2 m). Order 012-1221-00 (SD-42 and SD-46) **$735**

10 kHz to 21 GHz DC Block –
("N" Type). Order 015-0509-00 ..... **$430**
(K to "N" type adapter). Order 015-0369-00 ..... **$49**

INTERNATIONAL POWER PLUG OPTIONS (SA-42 AND SA-46 ONLY)
Opt. A1 – Universal Euro 220 V, 50 Hz. (161-0104-06) ..... **NC**
Opt. A2 – United Kingdom 240 V, 50 Hz. (161-0104-07) ..... **NC**
Opt. A3 – Australian 240 V, 50 Hz. (161-0104-05) ..... **NC**
Opt. A4 – North American 240 V, 60 Hz. (161-0104-08) ..... **NC**
Opt. A5 – Switzerland 220 V, 50 Hz. (161-0167-00) ..... **NC**
See General Customer Information Section for additional description.

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

Optical Impulse Generators

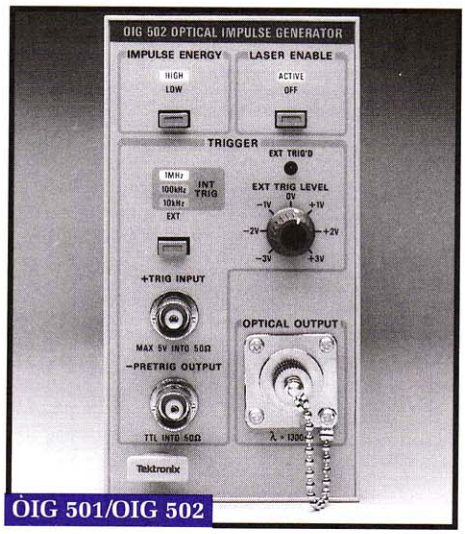
The OIG Series products generate extremely narrow laser impulses for use in general purpose optical reflection measurements and opto-electronic device characterization.

OIG 501/OIG 502

- Optical Wavelength
  - –OIG 501-850 nm
  - –OIG 502-1300 nm
- Near Gaussian Pulse Shape (Low Energy Mode)
- Easy to Use Front Panel Controls
- Compact/Small Size
- Selectable Pulse Repetition Rates
- Multiple Optical Connector Types Accommodated
  - –FC/PC
  - –DIN 47256
  - –ST*
  - –SC

TYPICAL APPLICATIONS

- Millimeter Resolution Optical Time Domain Reflectometry
- Optical Reflection Measurement
- Optical Component Characterization



OIG 501/OIG 502

OIG 501/OIG 502

The OIG 501/OIG 502 Optical Impulse Generators are laser impulse sources that operate at 850 and 1300 nm respectively. The OIG 500 Series sources produce very narrow and stable optical pulses at various user selectable repetition rates.

The user may select either internal or external triggering. The trigger level can be adjusted from ±3 V. The internal triggering repetition rates are 10 kHz, 100 kHz or 1 MHz. These rates are selectable with front panel switches.

The output is stabilized to provide repeatable output signal levels. These units are compatible with either the Tektronix TM 500 or TM 5000 Series Modular Instrument Mainframes.

The OIG 501/OIG 502 have two user-selectable output pulse modes: high impulse energy or low impulse energy. The OIG 501/OIG 502 have a 60 ns pre-trigger for easy viewing of the impulses on a variety of oscilloscopes.

Highly stable measurements are made possible by a trigger jitter of ≤5 ps (RMS) and an impulse amplitude variation of <±10% at impulse repetition rates between 10 kHz and 1.0 MHz.

MILLIMETER RESOLUTION OPTICAL TIME DOMAIN REFLECTOMETRY

When combined with other Tektronix instruments such as an optical to electrical converter (OCP5000, P6700 or SD/SA-40 Series products) and a high performance oscilloscope (CSA 404, CSA 803, 11400, or 11800 Series products) the OIG500 Series Optical Impulse Generators can be used to perform extremely high resolution optical time domain reflectometry (OTDR).

These OTDR measurements allow the precise location of Fresnel reflecting single events to <0.1 millimeter. Multiple Fresnel reflectors can be precisely located and measured even when they are spaced as close together as 2 centimeters.

For more information on this application request Tektronix Application Note #3TW-8058-1 ("High Resolution Optical Reflection Testing with the Tektronix OIG 500 Series Optical Impulse Generators").

OPTICAL REFLECTION MEASUREMENTS

Optical reflections in fiber optic systems can seriously degrade transmission performance, especially in high-speed communications links using laser sources. Characterization of reflective performance of optical connectors and components can be crucial to ensuring signal integrity in these systems. Multiple reflections can occur throughout the optical pathway. It is useful for designers to identify and isolate the specific sources of these reflections.

The OIG 500 Series instruments can be used with the Tektronix CSA 803, CSA 404 Communication Signal Analyzers or other 11000 Series oscilloscopes to evaluate optical reflections. The return loss of optical reflections can be measured to 50 dB levels.

OPTICAL COMPONENT CHARACTERIZATION

With the OIG 500 Series and the CSA 803 or CSA 404, the user can easily characterize optical devices in terms of their frequency response, rise time, and aberration levels.

Characteristics

	OIG 501	OIG 502
Wavelength	850 nm*1	1300 nm*2
Impulse Width		
Low Energy	≤35 ps	≤35 ps
High Energy	≤300 ps	≤300 ps
Max Output Optical Power		
Low Energy	≥15 mW	≥5 mW
High Energy	≥30 mW	≥15 mW
Impulse Amplitude Variation	≤10% from 10 kHz to 1.0 MHz	
External Trigger	DC to 1.0 MHz	DC to 1.0 MHz
Internal Trigger	10 kHz 100 kHz 1.0 MHz	10 kHz 100 kHz 1.0 MHz

*1 ±50 nm *2 ±20 nm

Note: For further technical information request Product Data Sheet #3TW-7797-1.

**ST is a registered trademark of AT&T*

ORDERING INFORMATION

OIG 501
Optical Impulse Generator.....**$9,250**
Includes: Instruction manual (070-7817-01).

OIG 502
Optical Impulse Generator.....**$9,750**
Includes: Instruction manual (070-7818-01).

OPTIONAL ACCESSORIES
Fiber Optic Cables – Refer to Page 227 for complete list.

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

Optical Attenuators

OA5002
OA5012
OA5022

OA5002/OA5012/OA5022

A Vital Link in Optical Systems Analysis

Tektronix Programmable Optical Attenuators provide a convenient, accurate and cost-effective means of controlling optical power levels in fiber optic media.

The OA5000 Series instruments provide variable attenuation of single and multimode fiber optic signals commonly used in communications equipment. Attenuation levels can be varied manually, using the front-panel controls or automatically via programmable computer control. These instruments are packaged as compact single-wide plug-in units compatible with Tektronix TM 5000 Series Modular Instrument Mainframes. Six units will fit side-by-side in a TM5006 Mainframe taking up approximately seven inches of vertical space in a standard 19 inch wide equipment rack.

TYPICAL APPLICATIONS

Communication standards using optical components typically require that the receiver operate over a given optical power range. This specification is tested by monitoring the bit error rate (BER) as a function of optical power. The CSA 907 BER Test Set and OA5000 Series Optical Attenuators meet the requirements for performing this test.

FDDI/LAN DESIGN

Using the OA5000 Series Optical Attenuators with the CSA 907 BER Tester and the CSA 404 Communications Signal Analyzer, network equipment designers can characterize, with repeatable results, the system performance over the specified optical power range. Signal levels may range from –14 dBm to –24 dBm for FDDI systems. The OA5022 Optical Attenuators provide the signal level variation and input fiber size required for FDDI compliance testing.

SDH/SONET COMPLIANCE TESTING

SDH/SONET compliant signal levels may be as high as +2 dBm to as low as –34 dBm. To verify the performance of SONET equipment over these signal levels, it is necessary to have calibrated attenuators with at least this much range. The OA5002 is the attenuator of choice for SDH/SONET testing.

MANUFACTURING AND OTHER AUTOMATED TEST APPLICATIONS

Because the OA5000 Series Optical Attenuators are GPIB Programmable, these units can be operated in a completely automated environment. With the step size of 0.01 dB and a calibrated attenuation range of 0 to 60 dB (continuous), measuring parameters such as receiver linearity is quickly and reliably accomplished. Also with their storable attenuation levels, the OA5000 Series Optical Attenuators are very useful for repeat measurements in manufacturing environments.

Characteristics

Wavelength Range	750 to 1600 nm
Input	
OA5002	Single Mode fiber
OA5012	50 µm Multimode fiber
OA5022	62.5 µm Multimode fiber
Insertion Loss	≤ 2.0 dB
Return Loss	≤ –45 dB*1
	≤ –25 dB*2
Attenuation Range	≥ 60 dB*3
	≥ 50 dB*4
Disable	≥ 100 dB
Repeatability	±0.05 dB
Linearity	±0.05 dB

*1 OA5002 *3 750-1350 nm
*2 OA5012/OA5022 *4 1350-1600 nm

Note: [a]For further technical information request Product Data Sheet #3TW-8032-0.

[b]For information on OA5000 Series compatibility with other fiber sizes, contact your local Tektronix sales office.

OA5002/OA5012/OA5022

- 750 nm to 1600 nm Calibrated Spectral Response in One Unit
- Multiple Optical Connector Types Accommodated
  - –FC/PC
  - –DIN 47256
  - –ST
  - –SC
- GPIB, IEEE 488.2 Controllable
- Models for Single and Multimode Fiber
- Can be Mounted 6 Abreast in Standard Rackmount

APPLICATIONS

- Evaluate Receiver Sensitivity as a Function of Optical Power
- General Development of Fiber Optic Equipment
- SDH/SONET and FDDI Standards Testing
- OTDR Attenuation Measurement Calibration
- Optical Power Meter Linearity Calibration
- Manufacturing Test of Fiber Optic Equipment

The OA5000 Series products provide calibrated levels of optical path attenuators for use in general purpose fiber optic measurements and optical receiver characterization.

ORDERING INFORMATION

OA5002
Optical Attenuator **$7,250**
Includes: Single mode input and output; Universal Optical input and output connector; and Instruction Manual (070-7612-00).

OA5012
Optical Attenuator **$6,995**
Includes: 50 micron multimode input and output; Universal Optical input and output connector; and Instruction Manual (070-7612-00).

OA5022
Optical Attenuator **$6,995**
Includes: 62.5 micron multimode input and output; Universal Optical input and output connector; and Instruction Manual (070-7612-00).

OPTIONAL ACCESSORIES
Fiber Optic Cables – Refer to Page 227 for complete list.

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

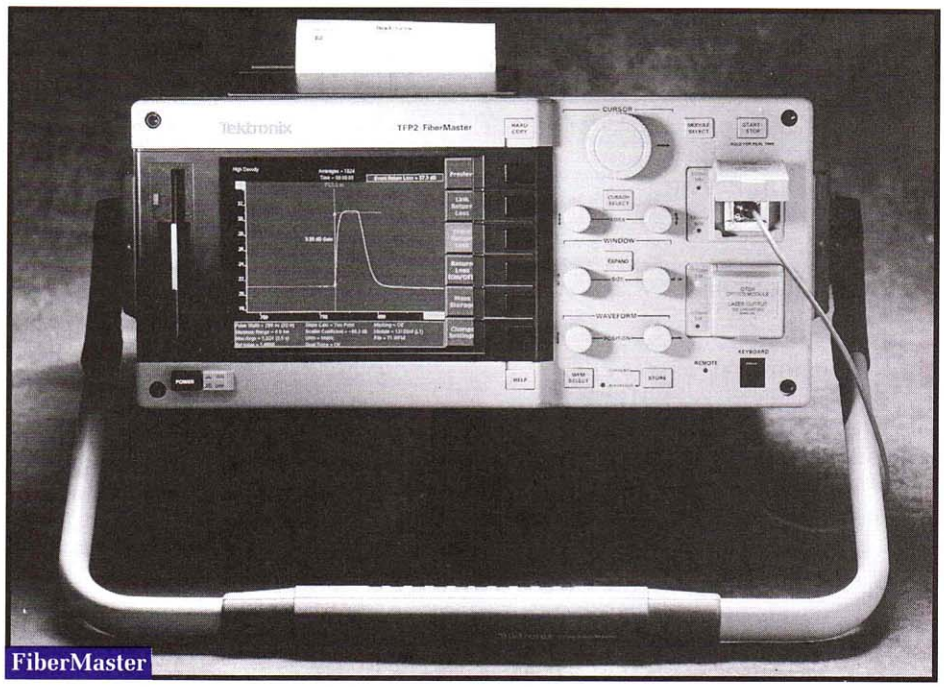
GPIB IEEE-488 — The OA5002/OA5012/OA5022 comply with IEEE Standard 488.2, and with Tektronix Standard Codes and Formats.

Optical Time Domain Reflectometer

Faster, easier, more efficient solution to Fiber Optic Network testing equipment.

FiberMaster

- High-Speed Processing
- User-Friendly
- High-Resolution Color Display System
- Custom Configurable Design
- Dual Optical Plug-in Capacity Mainframe
- High-Resolution and Long-Range Performance in Each Plug-in Optics Module
- Expandable Overview/Window Design
- Dual Trace Display Capability
- Automatic or Manual Mark Events
- Event Tables
- Pop-up Menus
- Automatic/Manual Masking
- High-Resolution Internal Printer (Optional)
- Link and Event Return Loss Capability
- MS DOS File Compatible
  - Floppy Disk Drive and/or Internal RAM
- AT Compatible Keyboard Interface
- GPIB and RS-232C Interfaces
- PC Trace Analysis Software



FiberMaster

FiberMaster™

Unlike any other OTDR on the market, the TFP2 FiberMaster sets a new level of performance and flexibility, providing faster, easier, more efficient solutions to fiber optic network testing requirements.

FiberMaster is the only OTDR equipped to accommodate two dual-wavelength optical plug-in modules at the same time. Fully utilized, this feature gives you dual-wavelength multimode and dual-wavelength singlemode optical cable testing at the touch of a button. This allows testing of virtually any communications network, Telco, CATV or LAN without switching modules.

FiberMaster is driven by a high-speed 32-bit processor that delivers clear, concise accurate waveforms in a fraction of the averaging time taken by other OTDR systems which are based on traditional PC technology.

Characteristics

CRT DISPLAY

Size – 16.5 cm (6.5 in.) diagonal.

Resolution – 640 x 480 pixels.

Type (color) – CRT with Liquid Crystal Color Shutter.

Cursors – Selectable, dual independent.

Module Capacity – Maximum 2 plug-in with 4 wavelengths.

HARDCOPY OUTPUT

Internal Printer – High-speed/res. dot matrix, thermal.

Resolution – 150 dots/in. vertical and horizontal (1.1 ratio to CRT Display).

Print Dimensions – 10.2 cm x 12.7 cm (4 in. x 5 in.).

GPIB to External – HPGL Plotter and HP ThinkJet.

RS232-C to External – HPGL Plotter, HP ThinkJet, Epson, Postscript.

Factory and User Selectable Defaults – Internal.

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-833-9200.

GPIB IEEE-488 — The Fiber Master complies with IEEE Standard 488.1-1987, and with Tektronix Standard Codes and Formats.

Optical Time Domain Reflectometer

NON-VOLATILE MEMORY

Mass Storage – MS DOS Compatible.

Internal Floppy Disk Drive – Size: 8.9 cm (3.5 inch).

Capacity – 1.44 Mbyte or 720 Kbyte.

Internal RAM – Capacity: 1 Mbyte, non-volatile.

Keyboard Interface – AT compatible.

DISPLAY RANGE

Vertical System – Vertical Display Range (one way): 1.0 dB to 50 dB. Loss Readout Resolution Range: 0.001 dB to 0.01 dB.

Mainframe Horizontal System – Distance Display Range: 1 m to 200 km. Distance Measurement Cursor Resolution 850 nm MM: 5 cm normal density; 1 cm high density 1300 nm MM, 1310 nm SM, 1550 nm SM: 20 cm normal density, 10 cm high density.

Index of Refraction Range – 1.4000 to 1.6000.

Distance Measurement Accuracy – ±0.001%, ± min. cursor resolution, ± uncertainty in fiber cal. factor.

Number of Stored Waveform Points – 16K max. (Normal), 32K max. (High Density).

PHYSICAL

Weight – 15 kg (33 lbs). Includes mainframe optics module, internal printer, disk drive.

Dimensions (including front cover, handle and feet) – Length: 60.7 cm (23.9 inches); Width: 45.2 cm (17.8 inches): Height: 19.8 cm (7.8 inches).

Power Requirements – AC Operation: 90-130 VAC, 47-440 Hz, 180-253 VAC, 47-73 Hz.

Laser Product Safety Classification – Class I.

ORDERING INFORMATION

FiberMaster with Color Display
Order TFP2 ..... **$12,600**
Includes: Operators Manual (070-7906-01); Soft Carrying Case (016-1037-00); Front Panel Cover(200-3566-00); Power Cord (161-0104-00).

OPTICS PLUG-IN OPTIONS – MULTIMODE
Opt. 01 – 850 nm MM. Order FM8500 ..... **+$7,000**
Opt. 02 – 1300 nm MM. Order FM1300 ..... **+$13,500**
Opt. 03 – 850 nm/1300 nm MM. Order FM8513 ..... **+$16,000**

OPTICS PLUG-IN OPTIONS – SINGLEMODE
Opt. 04 – 1310 nm SM. Order FS1300 ..... **+$15,000**
Opt. 05 – 1550 nm SM. Order FS1500 ..... **+$17,500**
Opt. 06 – 1310 nm/1550 nm SM. Order FS1315 ..... **+$23,000**
For Options 01-06 select connector option.

CONNECTOR OUTPUT OPTIONS – MULTIMODE
Opt. 20 – Biconic ..... **NC**
Opt. 21 – FC PC ..... **NC**
Opt. 22 – D4 PC ..... **NC**
Opt. 23 – SMA906 ..... **NC**
Opt. 24 – ST PC ..... **NC**
Opt. 25 – DIN47256 PC ..... **NC**
Opt. 26 – Diamond 3.5 ..... **NC**

CONNECTOR OUTPUT OPTIONS – SINGLEMODE
Opt. 30 – Biconic ..... **NC**
Opt. 31 – FCPC ..... **NC**
Opt. 32 – D4PC ..... **NC**
Opt. 34 – STPC ..... **NC**
Opt. 35 – DINPC 47256 ..... **NC**
Opt. 36 – Diamond 3.5 ..... **NC**
Opt. 38 – SCPC ..... **NC**

INTERNATIONAL POWER PLUG OPTIONS
Opt. A1 – Universal Euro 220 V, 50 Hz ..... **NC**
Opt. A2 – United Kingdom 240 V, 50 Hz ..... **NC**
Opt. A3 – Australian 240 V, 50 Hz ..... **NC**
Opt. A4 – North American 240 V, 60 Hz ..... **NC**
Opt. A5 – Switzerland 220 V, 50 Hz ..... **NC**

WARRANTY-PLUS SERVICE OPTIONS
Opt. M7 – Calibration Service ..... **+$235**
Opt. M9 – Repair Protection ..... **+$690**

ADDITIONAL ACCESSORIES
Factory Installed Options
Opt. 11 – 3.5 inch Floppy Disk Drive ..... **+$400**
Opt. 14 – Internal RAM, 1 MB ..... **+$870**
Opt. 16 – Internal High Speed Thermal Printer ..... **+$1,400**
Opt. 17 – DC Power Input (10-32 VDC) ..... **+$895**

FIELD INSTALLED OPTIONS
Trace Analysis Package PC Software. Order FMTAP ..... **+$1,495**
Opt. 19 – AT Compatible Keyboard. Order 118-7637-00 ..... **+$200**
Opt. 1R – Rack Mount Kits (fits 19 in./23 in. racks) *1
Opt. 1T – Hard Shell Transit Case. Order 016-1036-00 ..... **+$895**

OPTICS MODULES/CONNECTOR OUTPUTS
When ordering Optics Module connector outputs for previously purchased mainframes, use the following numbers:
FM8500 – 850 nm Multimode, 62.5 µm **$7,000**
FM1300 – 1300 nm Multimode 62.5 µm **$13,500**
FM8513 – 850 nm/1300 nm Multimode 62.5 µm **$16,000**
FS1300 – 1310 nm Singlemode **$15,000**
FS1500 – 1550 nm Singlemode **$17,500**
FS1315 – 1310 nm/1550 nm Singlemode **$23,000**

**1 Contact your local Tektronix representative for price information.*

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-833-9200.

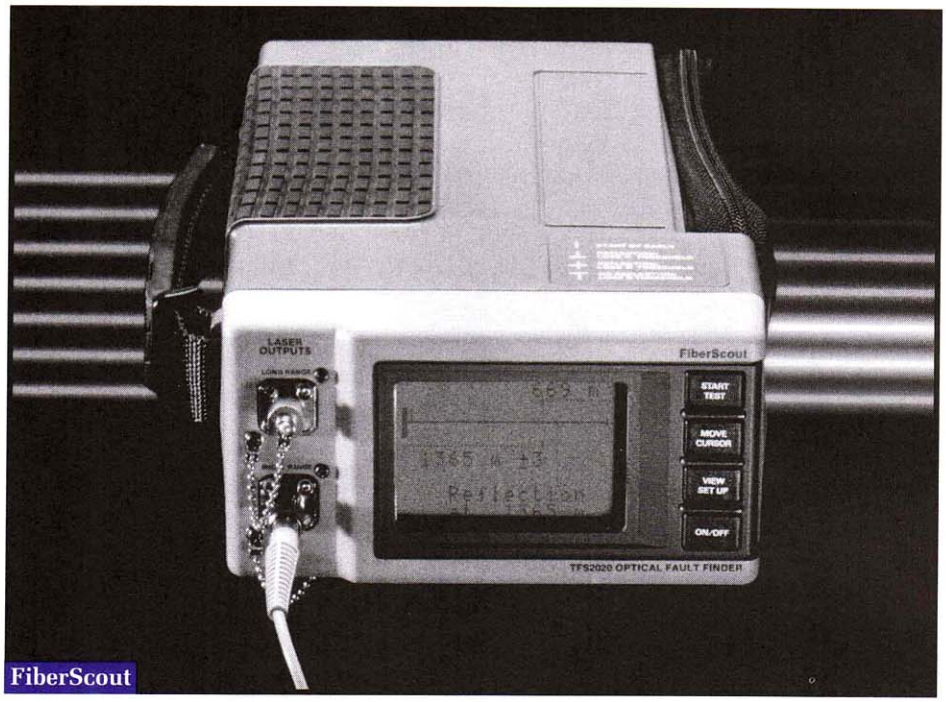
GPIB IEEE-488 — The Fiber Master complies with IEEE Standard 488.1-1987, and with Tektronix Standard Codes and Formats.

Handheld Optical Fault Finder

Priced for widespread use in cable restoration environment.

FiberScout

- Simple Symbolic Display
  - –Graphics
  - –Event Descriptions
- Fast Restoration Capability
- Small, Lightweight, Easy to Handle
- Easy One-button Operation
- Low Cost-High Performance
- Extended Long Range
- Long Range
- Universal Short Range
- Multimode Short Range
- Dual Port Capability
- High Distance Accuracy
- User-selectable Fault Thresholds
- Internal Battery Operation
- Internal Test Result Storage
- RS232C Output Port: PC Interface, Seiko DPU-201G Printer, Seiko DPU-411 Printer
- PC Interface Software
- Rackmount Available



FiberScout

FiberScout®

Weighing just five pounds (2.3 kg.), the battery-operated Tektronix TFS2020 FiberScout reports the status of the fiber through four easy-to-understand symbols.

Designed primarily to locate events and faults in optical cable, the FiberScout is priced for widespread use in the cable restoration environment.

No waveform interpretation is necessary – making the FiberScout so simple to use, it allows fault finding by virtually any user, regardless of the person's level of training.

The FiberScout gives you faster restoration capability and greater service staff effectiveness, since it can be deployed in far greater numbers than the more complex, more expensive OTDRs.

Documentation is fast and simple when using either of the light-weight, portable Seiko thermal printers. FiberScout comes standard with non-volatile memory for internal storage of test results which can later be transferred to a PC.

For advanced documentation and storage needs, we also offer the FSTIP test interface package. Files are saved to the PC in ASCII form, which allows easy analysis of the representative trace and annotations of the results through virtually any word processor.

TD

Product also available within 24 hours through TekDirect. Call 1-800-426-2200

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-833-9200.

Handheld Optical Fault Finder

Characteristics

OPERATING PERFORMANCE*1

	Multimode Short Range	Universal Short Range	Long Range	Extended Long Range
Operating Distance Range*2	≥3.0 km @ 3.5 dB/km	≥3.0 km @ 2.5 dB/km	≥40.0 km @ 0.4 dB/km	≥64 km @ 0.25 dB/km
Fault Detection Range (one way)	≥10.5 dB @ 62.5 µm	≥7.5 dB	≥16 dB*3	≥16 dB
Distance Measurement Accuracy*4				
To Reflective Event	±2 meters	±2 meters	±5 meters	±5 meters
To Non-Reflective Event	±2 meters	±2 meters	±5 to 20 meters*5	±5 to 30 meters*5
Distance Readout Resolution	1 meter or 1 foot	1 meter or 1 foot	1 meter or 1 foot	1 meter or 1 foot
Two Event Resolution*6 Distance to Detect 2nd Reflection	≤10 meters	≤10 meters	≤40 meters	≤40 meters
Loss Measurement Repeatability	±0.2 dB	NA	±0.3 dB	±0.3 dB
Loss Readout Resolution	±0.1 dB	NA	±0.1 dB	±0.1 dB
Fault Threshold Selections	1, 2, 3, or 4 dB	NA*7	1, 2, 3, or 4 dB	1, 2, 3, or 4 dB
Optical Output				
Wavelength	835 nm ±35 nm	835 nm ±35 nm	1300 nm ±25 nm	1550 ±25 nm
Output Core Size	50 or 62.5 microns	8 to 10 microns	8 to 10 microns	8 to 10 microns
Display	Backlit LCD, Graphics and Text			
Laser Safety	Complies with Class I, 21 CFR 1040.10/1040.11			
Power — Internal	Rechargeable NiCad Battery Pack. Typical Operation life between charges: 6 hours. Typical shelf life between charges: 6 months.			
Power — External	AC/DC External Power/Charger Adapter			

*1 *In some cases, varying test conditions may affect measurement performance.*

*2 *With no events present.*

*3 *At the 4 dB fault threshold setting.*

*4 *Actual distance accuracy includes: timebase accuracy (±0.005%), quantization error in the Index of Refraction setting, and any uncertainty in the user's Index of Refraction value.*

*5 *With extended averaging invoked.*

*6 *The FiberScout automatically uses the optimal pulse width to separate the loss measurements between two adjacent events.*

*7 *For singlemode fiber, the FiberScout will report any loss ≥1 dB. For multimode fiber, the FiberScout will report any significant fault.*

ORDERING INFORMATION

FiberScout

Handheld Optical Fault Finder. Order TFS2020 ..... TD **NC**

Includes: Battery Pack (146-1000-01); 110 V AC/DC, Power Supply – USA/Canada (119-2731-00); Travel Case (016-1024-00); Accessory Pouch (016-0993-00); Operator Manual and Supplement (070-7167-03); Reference Label (062-9360-01).

With each FiberScout order, select one of the option groups listed below:

Opt. 01 – Equip with Long Range and Universal Short Range Ports ..... **+$8,200**

Opt. 02 – Equip with Long Range Port ..... **+$6,600**

Opt. 03 – Equip with Universal Short Range Port ..... **+$5,200**

Opt. 05 – Equip with Extended Long Range and Universal Short Range Ports ..... **+$12,600**

Opt. 06 – Equip with Extended Long Range Port ..... **+$10,800**

Opt. 09 – Equip with Multimode Short Range Port ..... **+$5,400**

Opt. MC – Equip with Multimode (50 µm) Short Range Port ..... **+$5,900**

Opt. MM – Equip with Long Range and Multimode (62.5 µm) Short Range Ports ..... **+$8,500**

Opt. MN – Equip with Long Range and Multimode (50 µm) Short Range Ports ..... **+$9,000**

AC/DC POWER SUPPLY OPTIONS

The FiberScout is equipped for use in the U.S.A. and Canada. If use is for other than in the U.S.A. or Canada, order one of the following options:

Opt. 1C – 220 V AC/DC Power Supply (Europe) ..... **NC**

Opt. 2C – 240 V AC/DC Power Supply (UK) ..... **NC**

WARRANTY-PLUS SERVICE OPTIONS

Opt. M7 – Calibration Service ..... **+$280**

Opt. M9 – Repair Protection ..... **+$530**

ADDITIONAL ACCESSORIES

Battery Pack – Order 146-1000-01 ..... **$85**

110 V AC/DC Power Supply (USA/Canada) – Order 119-2731-00 ..... **$30**

Travel Case – Order 016-1024-00*1 ..... **$85**

Accessory Pouch – Order 016-0993-00 ..... **$15.50**

Operator Manual and Supplement – Order 070-7167-03*1 ..... **$20**

Reference Label – Order 062-9360-01*1 ..... **$5.00**

*1 *For more information contact your local sales office or call toll free: 1-800-833-9200.*

Note: Units are not modular or customer modifiable. Any change in capability from originally ordered configuration, if available, must be performed by the factory or authorized Tektronix service center. Additional charges will apply.

TD

Product also available within 24 hours through TekDirect. Call 1-800-426-2200

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-833-9200.

Optical Power Meter

Accurate optical power and loss measurements in a single, rugged handheld unit.

FiberChamp™

- 3% Accuracy
- Multiple Calibrated Wavelengths: 780, 820, 850, 1060, 1300, 1310 and 1550
- Selectable dB Threshold Audio Indicator
- Readouts in dBm, dB and Watts
- Non-volatile Storage of Reference Power Level For Each Wavelength
- Averaging
- Analog Output Port
- Battery or AC/DC Operation

TYPICAL APPLICATIONS

- Absolute Power Measurements
- Link Loss
- Threshold Testing
- Monitoring Power Levels
- Representative Users
  - TELCO
  - CATV
  - LAN
  - R&D

FiberChamp

FiberChamp™

Weighing one pound (.45 kg), the FiberChamp Optical Power Meter provides the highest accuracy of any handheld optical power meter. FiberChamp is easy to use, with an intuitive user interface. The large backlit LCD display is easy to read in direct sunlight or total darkness.

FiberChamp interfaces to multimode and singlemode fiber and offers a wide selection of connector adapters.

Characteristics

ELECTRICAL/OPTICAL

These specifications apply for use with all singlemode and multimode fibers up to 200 µm, 0.3 NA core with all connector options.

Spectral Range – 750 nm to 1700 nm.

Calibrated Wavelengths – 780, 820, 850, 1060, 1300, 1310, 1550 nm.

Dynamic Range – +10 dBm to –70 dBm.

Accuracy – ±3% (±0.1 dB). See NOTE 1.

Readout Resolution – 4 digits, 0.01 dBm.

Display – Backlit LCD 6.98 x 5.08 cm (2.78 x 2.00 inch).

Power-Up Stabilization – < 5 seconds. See NOTE 2.

Tone Threshold Setting (dB) – 1, 3, 6, 10, 15, 20, 25, 30, 35, OFF.

Analog Output – Voltage: 0 to +1 V FSD of linear power range; Output Impedance: 5 kΩ; Nominal.

ENVIRONMENTAL

Temperature – Operating: -10°C to +45°C; Storage – -30°C to +75°C.

Humidity – 5 to 95% Relative Humidity, non-condensing.

Altitude – Operating: 4,500 meters (15,000 feet); Storage: 15,000 meters (50,000 feet).

POWER REQUIREMENTS

Internal – 9 V Alkaline (non-rechargeable) or 7.2 V, 6 cell NiCad (rechargeable).

Battery Life – Alkaline 28 hours, NiCad 8 hours.

External – 12-20 VDC (AC/DC converter) at 100 mA minimum.

PHYSICAL CHARACTERISTICS

Dimensions	in.	cm
Depth	3.74	9.5
Width	1.3	3.3
Height	7.91	20.1
Weight	**lb**	**kg**
Net	1	0.45

NOTE 1 – At –20 dBm at 22°C at calibrated wavelengths.

NOTE 2 – The FiberChamp must be at ambient temperature.

ORDERING INFORMATION

FiberChamp

Optical Power Meter. Order TFC200 ..... TD **$1,280**

Includes: Operator Manual (070-7913-00); User Guide (063-0809-00); Carrying Case (016-1078-00); Alkaline Battery (146-0094-00).

With each TFC200 order select one connector option listed below.

CONNECTOR ADAPTER OPTIONS

Standard configuration includes one connector adapter option of choice at no charge. Additional connector adapters may be ordered by part number indicated.

Opt. 20 – Biconic. Order 131-5078-00 ..... **+$50**
Opt. 21 – FC. Order 131-4728-00 ..... **+$50**
Opt. 22 – D4. Order 131-5080-00 ..... **+$50**
Opt. 24 – ST.*1 Order 131-5073-00 ..... **+$50**
Opt. 25 – DIN 47256. Order 131-5181-00 ..... **+$50**
Opt. 27 – SMA 905/906. Order 131-5072-00 ..... **+$50**
Opt. 28 – SC. Order 131-5182-00 ..... **+$50**

RECHARGEABLE POWER OPTIONS

(Standard configuration is non-rechargeable. Select one of the following if recharging capability is desired)

Opt. 0C – USA/Canadian 110 Volts ..... **+$45**
Opt. 1C – European 220 Volts ..... **+$65**
Opt. 2C – UK 240 Volts ..... **+$65**

ADDITIONAL ACCESSORIES

AC/DC Power Adapters (Provides AC operation only for standard non-rechargeable unit. Not required for instruments ordered with Rechargeable Power Option)

USA/Canadian 110 Volts – Order 119-2731-00 ..... **$30**
European 220 Volts – Order 119-2712-00 ..... **$45**
UK 240 Volts – Order 119-2713-00 ..... **$45**

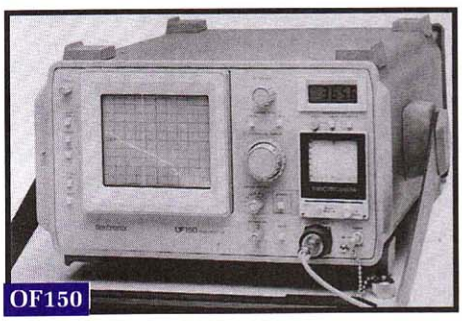
*1 *ST is a registered trademark of AT&T*

TD

Product also available within 24 hours through TekDirect. Call 1-800-426-2200

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-833-9200.

Optical Time Domain Reflectometer



OF150 Fiber Optic TDR

The high-performance, easy-to-use OF150 precisely measures signal loss and breaks on multimode fiber at the 850 nm wavelength. The instrument typically measures reflective breaks through 42.5 dB, and splice loss to ±0.1 dB through 21.5 dB of one-way cable loss, depending on fiber characteristics. Maximum read-out range is 19.9 km, with 1 meter resolution. Data point resolution is 2 cm.

Characteristics

OPTICAL TEST SIGNAL

Wavelength – 850 nm (±20 nm) (typical).

Displayed Pulse Width – LONG pulse: 5.5 meters, ±1 meter; SHORT pulse: 1.5 meters, ±0.3 meter

System Pulse Rate – 4.650 kHz, ±5 Hz.

Optical Output Amplitude – ≥25 μW Time-average power coupled into test fiber (50 μm core, 0.20 NA) (LONG PULSE mode, slow average).

ABSOLUTE MAXIMUM OPTICAL OUTPUT Amplitude – 70 μW averaged over time.

Displayed Pulse Risetime – <0.7 meters from -20 dB point to -6 dB point.

MEASUREMENT RANGE

Filtering – Decrease in RMS noise floor.
MEDIUM filter: 7.5 dB nominal.
SLOW filter: 15 dB nominal.

Optical Input Sensitivity – ≤0.40 μW input for 30 dB above displayed RMS noise floor.

Dynamic Range – (One Way) 29 dB (Scattering Signal measurements, SNR=1); 42.5 dB (Fiber End Detection assuming 4% Fresnel reflection).

SAFETY

Meets Class 1 Laser product safety classification under Radiation Control for Health and Safety Act of 1968.

PHYSICAL CHARACTERISTICS

	Cabinet Dimensions	
Dimensions	**cm**	**in**
(without front cover, handle or feet)		
Height	17.5	7.0
Length	32.69	13.07
Width	49.91	19.96
Weight	**kg**	**lbs**
(including standard accessories)		
	16.3	36.0.

OF150

- Multimode TDR
- Portable
- Rugged
- Easy to use

Easy to use and control. Built in CRT displaying sharp, defined traces without operator calculation or risk of error.

ORDERING INFORMATION

OF150 – Fiber Optic TDR **$15,600**
Includes: Blank Module (016-0782-00); Operator's Handbook (070-3678-01); AC Power Cord, Battery Power Cord, Optical Fiber Interface Cable, 2 Spare Fuses

Opt. 01 – XY1 Output Module ..... **+$300**
Opt. 04 – Chart Recorder ..... **+$1,050**

Must specify connector option when ordering.

Opt. 20 – Western Electric Connector (Biconic) ..... **NC**
Opt. 21 – Diamond 3.5 Connector ..... **NC**
Opt. 22 – FC Connector ..... **NC**
Opt. 23 – SMA 906 Connector ..... **NC**
Opt. 26 – ST Connector ..... **NC**
Opt. 27 – Deutsch 1000 Connector ..... **NC**

INTERNATIONAL POWER PLUG OPTIONS

Opt. A1 – Universal Euro 220 V, 50 Hz ..... **NC**
Opt. A2 – United Kingdom 240 V, 50 Hz ..... **NC**
Opt. A3 – Australian 240 V, 50 Hz ..... **NC**
Opt. A4 – North American 240 V, 60 Hz ..... **NC**
Opt. A5 – Switzerland 220 V, 50 Hz ..... **NC**

WARRANTY-PLUS SERVICE OPTIONS

Opt. M7 – Calibration Service ..... **+$340**
Opt. M9 – Repair Protection ..... **+$795**

ADDITIONAL ACCESSORIES

Chart Recorder – Order 016-0506-07 ..... **$1,745**
Hard Case (Transit) – Order 016-0658-00 ..... **$990**
Soft Case – Order 016-0659-00) **$155**
Chart Paper –
(Roll) Order 006-3618-00 ..... **$13.50**
(25 Rolls) Order 006-3618-01 ..... **$270**
(100 Rolls) Order 006-3618-02 ..... **$900**
Service Manual – Order 070-3677-03 ..... **$100**
Connectors, Receptacle and Optical (Opt. 27 only) –
(1 each) Order 131-2741-02 ..... **$90**
(10 each) Order 013-0207-02 ..... **$720**
Accessory Kit – (Deutsch) Tool/Plugs. Order 015-0474-00 ..... **$350**
CRT Visor – Order 016-0653-00 ..... **$60**
Optical Calibration Signal Generator –
Order 067-1049-01 ..... **$1,695**

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-833-9200.

Subscriber Loop Portable Test Set

Rugged, handheld test set designed to support multiple loop technologies from multiple vendors.

CrafTek

- Craft Tool for Subscriber Loop Installation and Maintenance:
  - –POTS/CLASS
  - –ISDN Basic Rate
  - –EBS (P-Phone)
- Highly Flexible Architecture for Easy Upgrading
- Rugged, Lightweight, Battery Operation
- ISDN Service Verification
  - – EOC and Cause Messages
  - – NEBE/FEBE Block Errors
  - – Info, LAP-D, and Call States
  - – Local Power
  - – Sealing Current
- EBS P-Phone Verification
  - – Call Appearance and Feature Verification
  - – DC Voltage
  - – Signaling Channel

CrafTek Subscriber Loop Portable Test Set.

CrafTek™ Subscriber Loop Portable Test Set

The CrafTek Subscriber Loop Test Set is designed to meet the changing needs of the telephony craftperson, with flexibility to handle rapidly evolving and increasingly sophisticated digital technologies. The platform is built to support multiple loop technologies from multiple vendors, allowing each unit to be custom-configured.

As ISDN standards evolve, such as ANSI 2B1Q, you can easily upgrade the CrafTek by simply snapping in up to three interface modules. When switch generics are released (for example, National ISDN-1), upgrading CrafTek's software is just as easy. The software EPROM is mounted in a simple module that the craftsperson plugs into a keyed module socket.

The CrafTek's ruggedness, portability and multiple power options assure use in any environment, minimizing customer downtime. Extensive ease of use features, like self-prompting plain-English menu displays, speed dialing, and stored settings assure users are productive from the start.

THE CRAFTEK: PUT IT TO WORK

Each CrafTek comes equipped for POTS service, with all the features of the analog craft test set you're used to using. In addition, CLASS service such as Calling Party ID can be captured and decoded.

In the ISDN environment, this portable hand-held set becomes the fundamental Basic Rate Service installation and maintenance tool.

For EBS P-Phone, the CrafTek goes much beyond a simple butt-in, allowing service verification and trouble shooting of EBS lines. A variety of operating modes and measurements are ideally suited to craft needs.

THE INTEGRATED CRAFT SOLUTION

During installation, the CrafTek allows you to turn up services even before customer premises equipment is delivered. Once the system is up and running, the CrafTek becomes the first line of defense, allowing location and repair of service problems on the first call. There's no longer the need to escalate the problem or rely on expensive protocol analyzers or multiple test equipment.

Continued on next page.

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

Subscriber Loop Portable Test Set

Characteristics

CrafTek PLATFORM

Display – Supertwist Liquid Crystal (LCD), Backlit.

User Interface – Easy-to-use menus with extensive user prompts and error messages via 4-line x 20 character LCD.

Power Supply – Rechargeable NiCad battery pack. Alkaline "C" cells, or 120 VAC with adapter. "Low Battery" and "Charging" indicators via LCD. Automatic shut-off.

Interface Ports – Four RJ45-type jacks (LINE, S/T(NT1), S/T(TE), AUXiliary).

Speed Dial – Storage for ten numbers (up to 22 digits per number) plus last number redial.

PHYSICAL ENVIRONMENT

Weather, moisture, dust and shock resistant. Designed for rugged field use.

EMI – Complies with FCC 47 CFR Part 15, Subpart J, Class A.

Size – 10.75 L x 3.25 D x 3.30 W (inches).

Weight – 3 lb., 6 oz., (with NiCad battery pack).

POTS

Dial Modes – DTMF, Pulse.

Functions – Meets monitor mode, talk mode, and acoustic response requirements as specified in Bellcore TR-TSY-000344.

Measurements – Polarity.

CLASS℠ – Support of "Customized Local Access Signaling Services" (Calling Line ID, with buffer).

ISDN TE

TE Compatibility – AT&T Type C and Type D terminal equipment; Northern Telecom terminal equipment; and National ISDN equipment.

Software Generics – Currently compatible with AT&T software generics up to and including 5E8, Northern Telecom DMS-100 up to and including BCS-34; National ISDN-1.

TE Functions – Provides basic voice services plus redirect. Supports B-Channel loopbacks using BRITL (Basic Rate Interface Test Line). Supports D-Channel X.25 Packet Data calling testing.

S/T Interface – Complies with T1.605-1991 ISDN Basic Rate Interface Specifications.

"T" Terminations – User selectable: Bridged, 100 Ω.

"T" Pad Attenuation – Range: 0 to 15 dB; Resolution: 1 dB.

"T" Synchronization – LED: Red=No Sync; Orange=Sync, not Activated; Green=Sync and Activated.

Hook LED – Red=Awaiting Dial Tone; Orange=Negative Acknowledgment; Green=Dial Tone/Active Call.

ISDN NT1

AMI Interface (Opt. 1B) – Meets specifications defined in AT&T Technical Reference 801-802-100 for AMI Loop Interface.

2B1Q Interface (Opt. 2B) – Meets specifications defined in ANSI T1.601-1988 (1991 Draft Revision) Standard. Complies with all 15 defined ANSI "U" loops. Supports Quiet and Insertion Loss Modes (AC/DC Triggers).

S/T Terminations – User selectable: Bridged, 100 ohm, 50 ohm.

"U" Pad Attenuation – Range: 0 to 42 dB; Resolution: 1 dB.

"U" Synchronization – LED: Red=No Sync; Orange=Sync, not Transparent; Green=Sync and Transparent.

ISDN MEASUREMENTS AND INDICATORS

Near End Block Errors (NEBE) – Total errors, errored seconds, selectable elapsed time.

Far End Block Errors (FEBE) – Total errors, errored seconds, selectable elapsed time.

Sealing Current – Presence with polarity indication.

2B1Q Battery – Presence with polarity indication.

Local Power – Presence with polarity indication.

S/T Power Sources 1, 2 and 3 – Presence with polarity indication.

TE Receive Level – Range: -9 dB to +3 dB; Resolution 0.5 dB.

Indicators via LCD – INFO ("F" and "G") States, LAPD and CALL States, B-Channel Assignment, TEI Number, ANI Number, CAUSE messages, and NT1 EOC messages.

BER Testing – Provides BER testing on either B-Channel.

EBS (P-PHONE)

P-Phone Interface (Opt. 3B) – Provides support for Northern Telecom "Electronic Business Service," including phone emulation for primary set, add-on sets, and Monitor mode (allows passive monitoring of voice and signaling channels); 2x16 message display.

P-Phone Measurements – DC Voltage and Polarity; Peak signal level of 8 kHz signaling channel; Signaling Message elements (Hex and decoded displays, with buffer).

ANALOG TERMINAL ADAPTER

ATA Interface (Opt. 1A) – Provides analog terminal adapter to connect analog devices (e.g., Craft Access) to ISDN or EBS lines.

**CLASS℠ is a service mark of Bellcore.*

ORDERING INFORMATION

CrafTek Subscriber Loop Portable Test Set

Order CT-100 ..... **$1,495**

Includes: User Manual (070-7895-02); Reference Card (070-7921-02); Rechargeable Battery Pack (016-1072-00); AC Adapter/Charger (119-2731-00); RJ11 to RJ11 Cord (012-1363-00); RJ45 to RJ45 Cords (012-1364-00); RJ11 to Bed-of-Nails Clips (012-1365-01); CLEI Number: TETQ3006AA.

Opt. 1A – ATA Interface ..... **+$195**

Opt. 1B – AT&T AMI "U" Interface ..... **+$495**

Opt. 2B – ANSI 2B1Q "U" Interface ..... **+$895**

Opt. 3B – EBS (P-Phone) Interface ..... **+$495**

Opt. 38 – Soft-Padded Carrying Case. (016-1073-00) ..... **+$60**

Opt. 46 – RJ45 to Bed-Of-Nails Clips. (012-1366-01) ..... **+$50**

WARRANTY

One year warranty

UPGRADES

For ordering information to upgrade existing CrafTek test sets with new interface options or the latest operating firmware, please contact your local Tektronix Representative or call the NMC at 1-800-426-2200 Ext. 99.

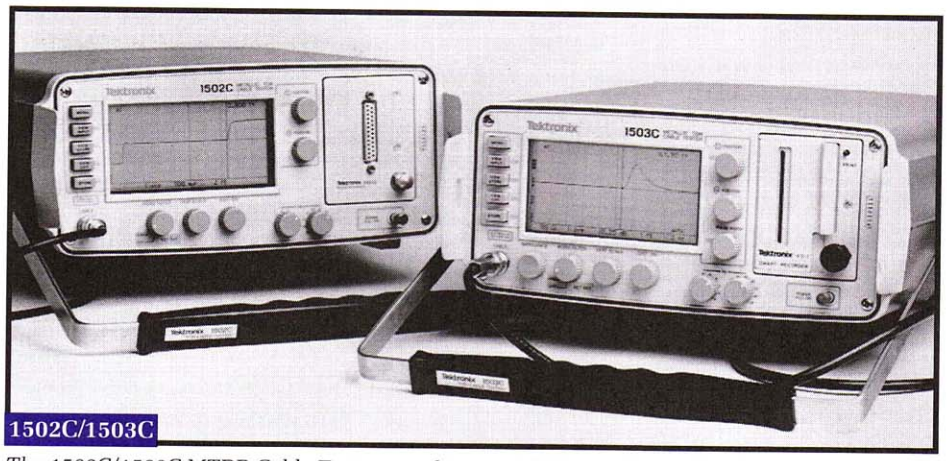
To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

1503C 1503B 1502C 1502B Metallic Cable Testers

Custom configure to meet your needs.

1502C/1503C
1502B/1503B

- Direct Distance Readout – Accurate to Better Than 1%
- Intermittent Fault Monitor Mode
- High Resolution LCD Display With Zoom
- Menu-driven Setup
- Help Mode
- Rugged Portability
- Calibrated Vertical Scale
- Optional Serial Interface
- Optional Internal Printer
- Noise Filtering



The 1502C/1503C MTDR Cable Testers combine portability and ease of use with the ability to test most dual conductor metallic cable under virtually any condition.

1503B/1503C
GENERAL PURPOSE CABLE TESTERS
These products generate a 1/2 sine pulse, with selectable pulse widths of 2, 10, 100, or 1000 nano-seconds. The high-resolution 2 ns pulse permits the identification of multiple faults as close together as one foot. The 1000 ns pulse gives the 1503C a range of 5,000 to 50,000 feet (depending on cable type and condition).

For most TDR applications, where determining distance to an impedance change is the key measurement, the 1503C/1503B are the best choice.

1502C/1502B ULTRA-HIGH RESOLUTION TDRS
The 1502C and 1502B generate a 200 picosecond rise time step pulse and have an output impedance of 50 Ω. The fast risetime permits the identification of multiple faults as close together as 0.6 inches.

Sample Applications

TELEPHONE
In addition to locating shorts, opens, splits, crosses and bridges, the 1503C or 1503B can be used to identify and locate load coils or pinpoint and map wet sections of cable (together with the YT1 printer).

LOCAL AREA NETWORKS
Cable and connector problems can be the biggest headache for the LAN installer. The 1503C's high resolution 2 ns pulse will precisely identify problems in seconds. The calibrated vertical scale can help identify marginal components before they cause problems, and a return call.

ON-BOARD SYSTEMS
The ultra high resolution of the 1502C or 1502B are perfectly adapted for testing critical wiring on board aircraft and ships.

MANUFACTURING QUALITY CONTROL
Manufacturers of circuit boards or precision cabling can quickly and accurately determine or verify the impedance characteristics of their products in a matter of seconds with the 1502C or 1502B.

ORDERING INFORMATION

1503C – Metallic TDR ..... TD **$4,950**
1503B – Metallic TDR **$5,850**
1502C – Metallic TDR **$6,950**
1502B – Metallic TDR **$7,850**
Includes: AC Power Cord; 50 Ω BNC Terminator; Precision 50 Ω Cable (1502); 93 Ω Cable (1503); BNC-Cliplead (1503); Female-to-female BNC Connector; Spare Fuse; Operator's Manual; Accessory Pouch; OptionPort Cover; Calculator Slide Rule.

Opt. 03 – Battery Pack ..... TD **+$250**
1500C Series products meet environmental requirements of MIL-STD-28800C for Type III, Class 3, Style C, and utilize a high performance internal gel-cell battery. 1500B Series products meet environmental requirements for Style A, and utilize a removable NiCad battery pack.

Opt. 04 – YT1 Chart Recorder ..... TD **+$950**
Records all information displayed on LCD, including waveform and settings for a permanent record.

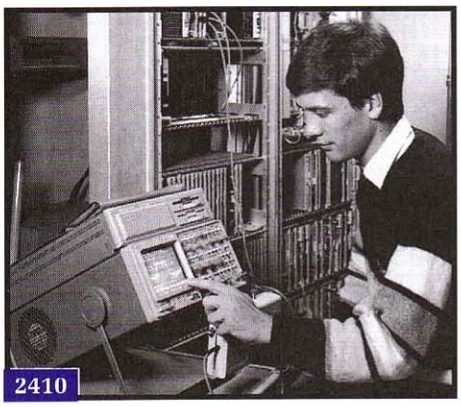
Opt. 06 – (1503 only) Live Ethernet testing capability ..... **+$350**
Opt. 08 – Token Ring TDR Adapter (1503 only) ..... **+$150**
Opt. 09 – USOC Adapter (1503 only) ..... **+$150**
Opt. 08 – Token Ring Interface (1503 only) ..... **+$350**
SP232 Serial Interface Module **$595**
Provides a serial link to a host PC for remote control, waveform storage, and automated fault finding. Includes host software for IBM-compatible PCs.

WARRANTY-PLUS SERVICE OPTIONS
Opt. M7 – Calibration Service
OF1503C/OF1503B ..... **+$240**
OF1502C/OF1502B ..... **+$275**
Opt. M9 – Repair Protection
OF1503C/OF1503B ..... **+$335**
OF1502C/OF1502B ..... **+$370**
A wide range of other options and connectors are available.

TD
1503C and Opt. 03 available within 24 hours through TekDirect. Call 1-800-426-2200

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-833-9200.

Digital Interface Test System



2410 Digital Interface Test System

TEST "TELECOM" SIGNALS AT THE DIGITAL SIGNAL CROSS-CONNECT

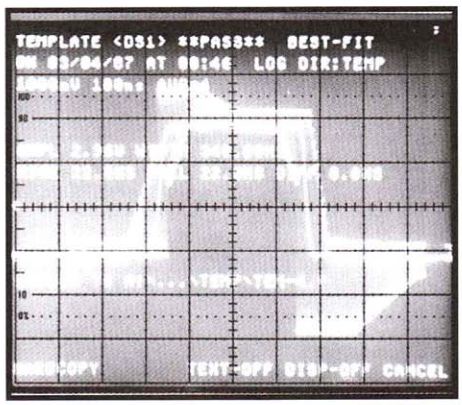
All tests are based on ANSI T1.102 and CCITT Blue Book Standard, Volume Three, Recommendation G.703. The 2410 performs pulse shape, pulse symmetry, and pulse spectral power tests. The system also allows multi-test looping, user-defined template generation, and can operate at the monitor jack on live traffic.

PULSE SHAPE TESTING

Tests are performed, with Tektronix-supplied templates, to ANSI DS1 (1.5 Mb) including Pub. 43802 old and new equipment specifications, DS1-C (3 Mb), DS2 (6 Mb), or DS3 (44 Mb). The T-Carrier Trigger unit captures an isolated "1" for this test. The 2410 can log each failure with a date and timestamp for unattended monitoring of signal lines. CCITT 2 Mb, 8 Mb or 34 Mb don't require the T-Carrier Trigger unit.

PULSE SYMMETRY (BALANCE) TESTING

Power imbalance is tested to within 0.5 dB, as required by ANSI. For CCITT, the 2410 tests amplitude and width ratios or the positive and negative pulses.



Pulse shapes can be compared against ANSI or CCITT standards.

PULSE SPECTRAL POWER TESTING

The 2410 selects five sequential pulses, then compares power in the second harmonic against power in the fundamental.

ZERO LEVEL TEST

Test the zero level before and after the pulse in accordance with the CCITT Standard. The value of a "zero" cannot exceed 10% of the nominal pulse amplitude.

GENERATING TEMPLATES WITH TGEN

The 2410 includes a program for template generation. Standard templates may be modified or you can create templates based on your own signals.

WARRANTY INFORMATION

Hardware: The 2400 Series Digitizing Oscilloscope carries a 3-year warranty, and Warranty-Plus service extensions are available. For further hardware warranty information see the Tektronix General Product Catalog, or contact your local Tektronix sales office.

Software: 90-day warranty covering software media (floppy disks) for materials and defects. Software operation carries no warranty.

2410 DITS

- Monitor Live Traffic
- ANSI Tests:
  - Pulse Shape
  - Pulse Balance
  - Pulse Spectral Power
- CCITT Tests:
  - Pulse Shape
  - Pulse Symmetry
  - Zero Level Test
- Portable, Rugged System

The 2410 Digital Interface Test System is a fully integrated hardware and software package that allows you to quickly and accurately test digital carrier pulses to ANSI or CCITT specifications.

ORDERING INFORMATION

2410
Digital Interface Test System for ANSI T-Carrier tests **$14,785**

Includes: T-Carrier Trigger, software for ANSI tests and all ANSI test templates, TGEN template generation software, 2440 Opt. 11 Digital Oscilloscope, 2402A TekMate controller with Opt. 21 Hard Disk.

HARDWARE OPTION

Opt. 03 – Word Recognizer Option for oscilloscope ..... **+$495**
Opt. 05 – Video Trigger Option for oscilloscope ..... **+$1,295**
Opt. 1R – Rackmount ..... **+$535**
Opt. 1C – Transit Cart (016-1013-00) ..... **+$115**
Opt. 1T – Transit Case (202-0302-00) ..... **+$465**
Opt. 1P – HC100 Color Plotter with GPIB cable (U.S. power) ..... **+$1,180**
Opt. 2P – HC100 Color Plotter with GPIB cable (Euro power) ..... **+$1,180**

INTERNATIONAL POWER PLUG OPTIONS

Opt. A1 – Universal Euro 220 V, 50 Hz ..... **NC**
Opt. A2 – UK 240 V, 50 Hz ..... **NC**
Opt. A3 – Australian 240 V, 50 Hz ..... **NC**
Opt. A4 – North American 240 V, 50 Hz ..... **NC**
Opt. A5 – Switzerland 220 V, 50 Hz ..... **NC**

SOFTWARE PRODUCTS

S37DITS
T-Carrier Trigger, ANSI and CCITT Test Software
Includes: all ANSI and CCITT test templates.
Order S37J103 ..... **$4,455**

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

Communications Signal Analyzer

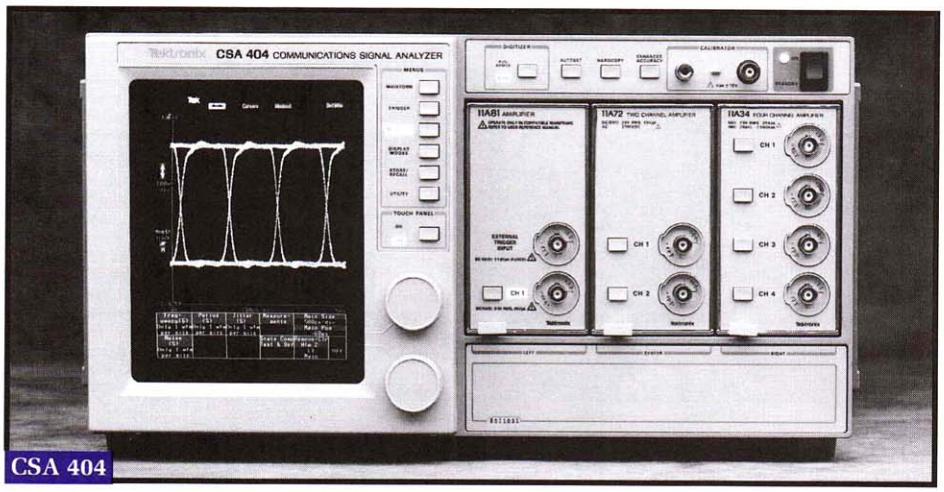
Specifically designed for communications applications, the CSA 404 Communications Signal Analyzer is the ideal tool for design, development, and production testing of telecommunications and data communications components, terminals, and systems.

CSA 404

- Choice of Bandwidths Through Modularity
- CSA 404: DC to 150, 300, 400, 600.
- Trigger up to 1 GHz, Trigger to 2 GHz with the 1181 Amplifier with up to 2 GHz Trigger Bandwidth
- Fully Automatic Jitter and Noise Measurements
- Infinite, Variable Persistence, and Color Graded Display Modes

APPLICATIONS

- Optical Standards Compliance Testing
- Electrical Standards Compliance Testing
- Timing Analysis
- Pass/fail Mask Measurements for Telecom (SDH/ SONET) and Datacomm (FDDI/ Fiberchannel)



CSA 404

The CSA 404 Communications Signal Analyzer is equipped with a comprehensive, communications-focused measurement set, on-board statistical database, variable persistence and color graded displays, histograms, mask testing, constellation diagrams, and optical waveform measurement capabilities. A large selection of modular plug-ins and sampling heads lets you easily reconfigure your communications test and measurement system for your particular needs.

MULTIPROCESSOR CONTROL PLATFORMS

A multiprocessor control platform allows functions previously managed by external computers and controllers to be performed within the analyzer itself. This sophisticated platform lets you generate measurement results – not just raw data – with time and voltage histograms, mask testing, and statistical pulse parameter measurements. It virtually eliminates the need for external computers and specialized software. And it provides a communications-focused measurement set that includes jitter, noise, duty cycle, overshoot, undershoot, extinction ration and amplitude measurements.

In addition, mask testing of SDH/SONET and FDDI compliant signals broadens your analysis capabilities. A full color display helps you discriminate waveform details, while variable persistence mode gives you the realtime feel of analog. A color-graded display mode adds a third dimension – sample density – to your signal acquisitions and analysis. And color hardcopy capabilities allow you to accurately document your measurement results.

MODULARITY ALLOWS CUSTOMIZATION

For applications up to 3 GHz, the CSA 404 combines extensive triggering capabilities with a 2 GHz trigger bandwidth. You can select AC or DC coupling, AC or DC noise rejection, as well as high and low frequency rejection.

High bandwidth probes are also available for constructing a total acquisition and measurement solution. The P6204 active probe offers 1 GHz bandwidth, while the P6150 and P6156 passive probes offer 9.0 and 3.5 GHz respectively. The P6204 and P6156 are quipped with Identify and Readout capabilities and provide key information, such as attenuation, input impedance and offset scale factor.

STATISTICAL DATABASE

A built-in statistical database gives the CSA 404 the ability to accumulate three-dimensional waveform data – time, voltage, and now *sample density*. The database is a 512 x 256 x 16-bit data array which accumulates waveform data by counting the number of times each pixel in the display is activated (Figure 1). This information is then displayed in a color-graded format that gives you a qualitative view of the acquired waveform data. You can view data distribution in eye and constellation diagrams at a glance.

The instrument provides a menu showing the sample density assigned to each color, giving you the ability to generate time and voltage histograms for any portion of the acquired waveform.

The power of this statistical database is the measurement capabilities – time and voltage measurements.

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

GPIB IEEE-488 — The CSA 404 complies with IEEE Standard 488.1-1987, RS-232C and Tektronix Standard Codes and Formats.

Communications Signal Analyzer

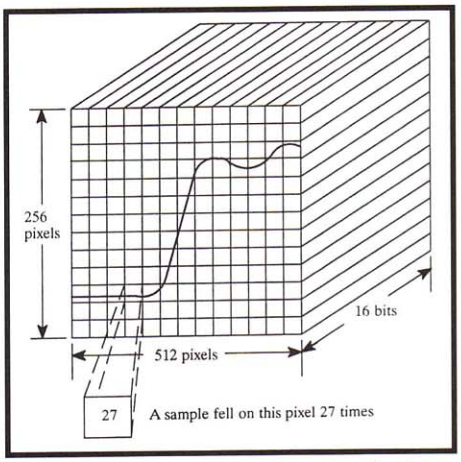


Figure 1: The unique 512 x 256 x 16-bit data array counts and records the number of times each pixel in the display is activated.

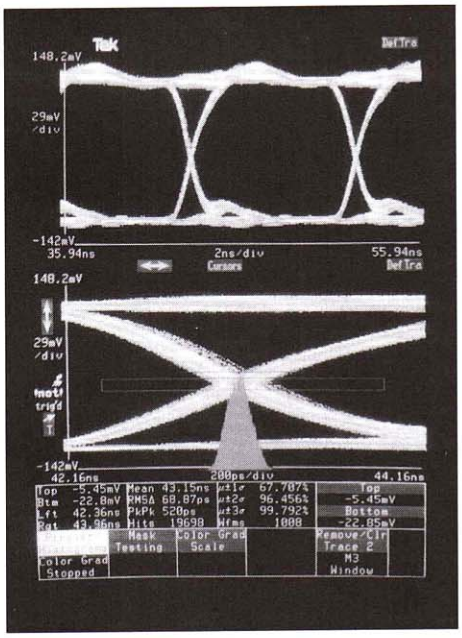


Figure 2: Histograms let you make extremely accurate jitter and noise measurements with one Data Acquisition.

HISTOGRAMS

Time and voltage histograms are powerful statistical tools for measuring noise and jitter in communication signals. The histograms include useful information such as mean, rms deviation, and peak to peak, and are displayed and continuously updated at a user-selectable rate (Figure 2). High sample rates make it possible to analyze data concurrent with acquisition, rather than in a batch mode later on. The statistical data base allows you to change histogram parameters without reacquiring data.

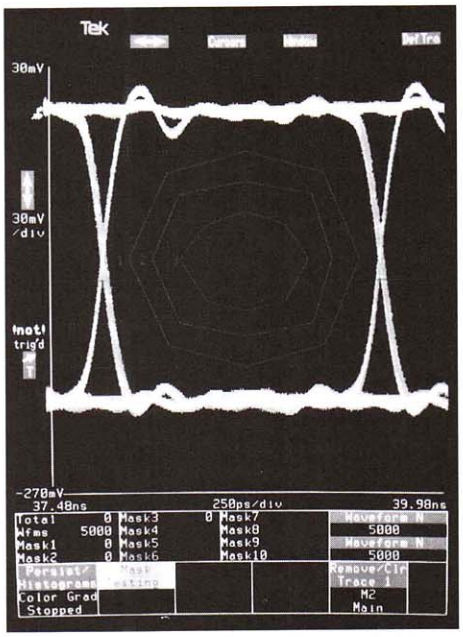


Figure 3: You can perform tolerance testing with the unique mask testing capabilities of the Communications Signal Analyzers.

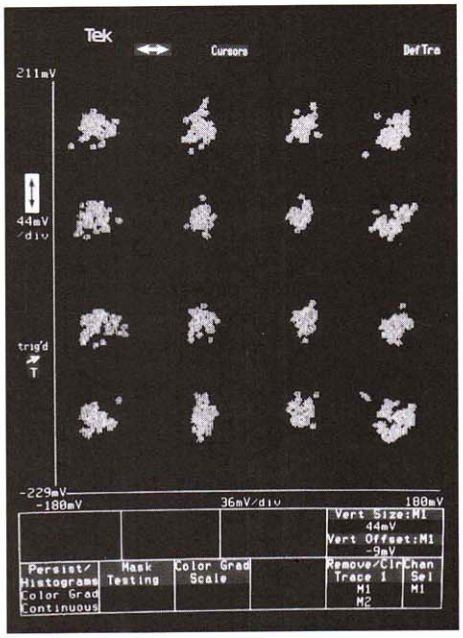


Figure 4: The CSA 404 lets you generate constellation diagrams for analysis of digital RF systems.

AUTOMATIC JITTER AND NOISE MEASUREMENTS

For the first time, you can make jitter and noise measurements with one simple selection from an on-screen menu. Controls are provided, with default settings, for adjusting left and right limits, selecting rms or pk-pk, tracking on/off, and absolute or relative positions. For eye diagrams, you can select either the eye crossing or the mesial level for the jitter measurement location. Either top line or base line can be selected for the noise measurements. The CSA does the rest, and displays the jitter and noise measurements in the status menu at the bottom of the screen.

AUTOMATIC PULSE PARAMETER MEASUREMENTS

Until now, automatic timing measurements such as "clock to data" phase measurements were not possible on random data such as eye diagrams. With the Tektronix-proprietary statistical measurement mode you can make all automatic pulse parameter measurements directly on random data.

In addition, you can make automatic extinction ratio and amplitude measurements for laser diodes, optical receiver components, and other optical devices. The CSA 404 offers 24 automatic measurements. Each will display up to six selected measurements simultaneously. All measurement results are updated continuously, as are the mean and standard deviation statistics for each measurement.

MEASUREMENT STATISTICS

Measurement statistics – including mean, *minimum value*, maximum value**, and standard deviation – can be automatically generated and displayed for all measurements. In the CSA 404, you *can display the statistical results of up to six measurements simultaneously in the statistic pop-up menu*, accessible through the measurements menu. This powerful feature gives you a clear picture of circuit operation over time, simplifies performance characterization, and provides for statistical quality control.

PASS/FAIL TESTING

Boundary conditions can be defined for all pulse parametric measurements. After running a test, two summary modes are available. Go/no go gives a quick green/red status indication. For a more complete characterization, the Statistical mode gives a summary of all measurement types.

VARIABLE PERSISTENCE AND COLOR GRADED DISPLAYS

You can view up to 8 waveforms at once in any of the four available persistence modes – normal, infinite, variable and color-graded. Variable persistence lets you examine signal aberrations over a specified period of time from 200 ms to 20 seconds, and gives you the feel of realtime analog. The unique use of color-graded persistence clearly exhibits the sample density on all parts of the waveform.

Continued on next page.

Communications Signal Analyzer

MASK TESTING
For tolerance testing in design or on the manufacturing floor, you can define and edit up to 10 masks simultaneously. These masks (polygons) may each have up to 50 vertices (Figure 3). The CSA 404 then counts the individual and total samples that fall in each of the defined masks. You can store defined masks for future use.

CONSTELLATION DIAGRAMS
The CSA 404 meets the qualitative testing requirements of digital RF testing applications with the ability to check your QAM or QPSK signals for faults such as unequal gaps, rotation, compression, and amplitude oscillation.

OPTICAL WAVEFORM ACQUISITION AND ANALYSIS
The P6700 Series of Optical to Electrical Converters transform your CSA 404 into a powerful tool for characterizing, calibrating or troubleshooting electro-optic devices such as diode lasers, LEDs, electro-optic modulators, and optical waveguides. Network designers can use these converters to develop fiber optic control networks, LANs, and optical disk storage systems.

When any of the P6700 Series converters are connected to the CSA 404, scale factors are automatically changed to mW, µW or nW in order to show optical average or pulse power levels of the incoming signals, eliminating the need for tedious calculations.

With the OIG 501/OIG 502 Optical Impulse Generators and the OCP 5002/OCP 5502 Optical to Electrical Converter/Power Meter complete optical test and measurement systems can be constructed. These high performance tools make complete optical system component measurements effortless for even the novice.

The CSA 404 offers the performance you need to work with the emerging SDH/SONET and FDDI standards, and the modularity you need to adapt your system as new standards are introduced.

Characteristics

VERTICAL SYSTEM WITH ENHANCED ACCURACY

ΔVDC Accuracy – ≤1% for an 8-division signal.

Absolute DC Accuracy – ≤0.6% when using full scale of the plug-in offset range.

ENHANCED ACCURACY automatically expires when the instrument temperature changes by approximately ±5°C from the temperature of the last calibration. Even if the ENHANCED ACCURACY is not renewed, the accuracy typically remains ≤ 2%.

11000 Series Probes can be included in calibration. The instrument will prompt you to connect the probes to the CALIBRATOR.

Vertical Resolution – 10 bits (1024 levels). Resolution can be increased to 14 bits (16384 levels) with signal averaging.

Equivalent-Time Bandwidth – 3 GHz max determined by plug-in. See page 78.

HORIZONTAL SYSTEM

Time Bases – Two independent, built-in time bases.

Record Duration – 5.11 ns to 1024 s.

Time Base Accuracy – 100 ps +0.002% of measurement interval.

Record Length – 512, 1024, 2048, 4096, 5120, 8192, and 10240 points.

Sampling Rate – 20 MS/s max.

Main Record Positioning – The main record is positioned with respect to the main trigger point. Pretrigger: One record duration. Posttrigger: One record duration. Resolution: One main record point.

Windows – The main record plus two window records can be acquired and displayed. The window records can be of a different length (duration) and can have a shorter time/div than the main record. If two window records are used, they have the same duration and time/div settings, but can be positioned independently.

Window Record Positioning – The window records are positioned relative to a window trigger point which can be delayed by either time or events relative to the main record's trigger point.

Main-to-Window Trigger Time Measurements – The time between the Main record trigger and the Window trigger can be measured precisely, even if each trigger only occurs once. Repetitive events allow this measurement to be averaged for better resolution and accuracy.
Single Trigger Resolution: 200 ps
Repetitive Resolution: 10 ps with averaging
Accuracy: 250 ps +0.002% of measured interval.

TRIGGERING SYSTEM

Range – ± Full Scale.

Main Trigger, Coupling and Sensitivity: Jitter (Typical) – 10 ps rms; 70 ps peak-to-peak.

DC Coupled – 0.5 div from DC to 50 MHz; 1.5 div from 50 MHz to 3 GHz.*1

Noise Reject Coupled – 1.2 div or less from DC to 50 MHz; 3 div from 50 MHz to 3 GHz.*1

AC Coupled – 0.5 div from 60 Hz to 50 MHz; 1.5 div from 50 MHz to 1 GHz.*1 Attenuates signals below 60 Hz.

HF Reject Coupled – 0.65 div from DC to 30 kHz.

LF Reject Coupled – 0.65 div from 80 kHz to 50 MHz; 1.5 div from 50 MHz to 1 GHz.*1

Window Trigger, Coupling and Sensitivity:
DC Coupled – 0.5 div from DC to 50 MHz; 1.5 div from 50 MHz to 500 MHz.*1

Noise Reject Coupled – 1.2 div or less from DC to 50 MHz; 3 div from 50 MHz to 500 MHz.*1

AC Coupled – 0.5 div from 60 Hz to 50 MHz; 1.5 div from 50 MHz to 500 MHz.*1 Attenuates signals below 60 Hz.

HF Reject Coupled – 0.65 div from DC to 30 kHz.

LF Reject Coupled – 0.65 div from 80 kHz to 50 MHz; 1.5 div from 50 MHz to 500 MHz.*1

Holdoff Range:
Main Record – Min: 490 ns; max: 10x.

Window Triggering – By time, or event.

MEASUREMENT SYSTEM

Waveform Processing Functions:
Waveform Functions – Differentiate, integrate, interpolate, smooth, average, envelope, square root, signum, logarithm, natural log, absolute value, and exponential.

Arithmetic Operators – Add, subtract, multiply, divide.

Measurement Set:
Amplitude – Min, max, mid, mean, gain, p-p, undershoot, overshoot, amplitude, noise, extinction ratio, and RMS.

Timing – Rise, fall, width, delay, main-to-window trigger time, phase, period, duty cycle, skew, jitter, propagation delay, cross, and frequency.

Area and Energy – Area +, area –, and energy.

Measurement Statistics – Min, max, mean, and standard deviation of all active measurements.

Cursors – Dual dots in split or paired mode, horizontal and vertical bars, measurement zone delimiters.

*1 *At minimum holdoff setting.*

Communications Signal Analyzer

INPUTS/OUTPUTS
Centronics, GPIB, and RS-232-C ports standard. Fully GPIB and RS-232-C programmable.

Hardcopy Drivers – Support for Tektronix HC200A and 9 pin and 24-pin Epson-graphics compatible printers; Tektronix HC100 and HPGL-compatible plotters; Tektronix 4693, 4696, 4697 color printers; H-P Laserjet and Thinkjet printers; bit map transfer to computers. Draft, high resolution, and reduced modes.

CRT AND DISPLAY FEATURES
CRT – Magnetic deflection, vertical raster-scan orientation. 7.5-inch diagonal color CRT.

Colors – Eight-color set; selectable from a palette of 262, 144 colors.

Video Resolution – 552 horizontal by 704 vertical displayed pixels.

ENVIRONMENTAL AND SAFETY
Temperature – Operating: 0 to +50°C. Nonoperating: –40 to +75°C.

Humidity – Operating and Nonoperating: Up to 95% relative humidity, up to +50°C.

Altitude – Operating and Nonoperating: meets MIL-T-28800C, Type Class 5.

Electromagnetic Compatibility – Referenced to MIL-STD-461B. Meets FCC part 15, subpart J, class A. Meets VDE 0871/6.78 for Class "B."

Vibration – Operating: meets MIL-T-28800C, Section 4.55.3.1, Type Class 5.

Shock – Nonoperating: meets MIL-T-28800C, Section 4.5.5.4.1, Type Class 5.

Bench Handling – Operating: meets MIL-T-28800C, Section 4.5.5.4.3., Type Class 5. Electromagnetic Compatibility - Meets the following requirements of MIL-STD-461B - CE-03, Part 4, Curve 1; CS-01, Part 7; CS-01, Part 4; CS-06, Part 5; RE-02, Part 7; RS-01, Part 4; RS-02, Part 5; RS-03, Part 7 (limited to 1 GHz). Meets FCC part 15, subpart J, class A. Meets VDE 0871/6.78 for Class B.

Safety – Listed UL 1244; CSA Bulletin 556B, Sept. 1973; Tektronix self-certification to comply with IEC 348 recommendations.

PHYSICAL CHARACTERISTICS

	Benchtop		Rackmount	
Dimensions	**mm**	**in.**	**mm**	**in.**
Width	448	17.6	483	19.0
Height	238	9.4	222	8.8
Depth	599	23.6	550	21.6
Weight ≈	**kg**	**lb**	**kg**	**lb**
Net	20.0	44	22.0	46.0
Shipping	24.0	44	25.0	54.0

ORDERING INFORMATION

CSA 404
Communications Signal Analyzer **$22,000**
Includes: Tutorial manual (070-8185-00), User Reference (070-8186-00), Programmer Reference (070-8187-00), Quick Reference (070-8188-00), Service Reference (070-8189-00), Power Cord, U.S., 120 V (161-0066-00).

SOFTWARE
See Software Section for selection guide and complete description of utility software available for the CSA 404.

INSTRUMENT OPTIONS
Opt. 1C – Cable Feedthrough Connectors. ..... **+$200**
Opt. 1R – Rackmount. ..... **+$250**
Opt. 2D – Memory Expansion Adds 768 kbytes of nonvolatile memory for storage of waveforms and settings. ..... **+$1,500**
Opt. 4D – DMA Controller increases transfer speed over GPIB. ..... **+$400**

INTERNATIONAL POWER PLUG OPTIONS
Opt. A1 – Universal Euro, 220 V, 50 Hz ..... **NC**
Opt. A2 – United Kingdom, 240 V, 50 Hz ..... **NC**
Opt. A3 – Australian, 240 V, 50 Hz ..... **NC**
Opt. A4 – North American, 240 V, 60 Hz ..... **NC**
Opt. A5 – Switzerland, 220 V, 50 Hz ..... **NC**
See General Customer Information Section for additional description.

WARRANTY-PLUS SERVICE OPTIONS
Opt. M7 – Calibration Service ..... **+$435**
Opt. M9 – Repair Protection ..... **+$1,225**
Opt. Q2 – Customer Site HW Service ..... **+$1,395**

PROBES
See Probe Section on page 423 for Selection Guide.

ADDITIONAL ACCESSORIES
Cart – Instrument cart with tilt tray, drawer, power strip. Order K220 ..... **$695**
Cables – RS-232-C, 10 ft. Order 012-0911-00 ..... **$100**
Centronics, 10 ft. Order 012-0555-00 ..... *1
GPIB Cable – *1
Blank Panels – Sampling Head. Order 200-3395-00 ..... **$0.85**
Camera – Order C-9 with Opt. 11 and Opt. 1A **$740**
Plotter – Order HC100 ..... **$1,075**
*1 *Contact your local Tektronix representative for price and ordering information.*

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

GPIB IEEE-488 — The CSA 404 complies with IEEE Standard 488.1-1987, RS-232C and with Tektronix Standard Codes and Formats.

Communications Signal Analyzer

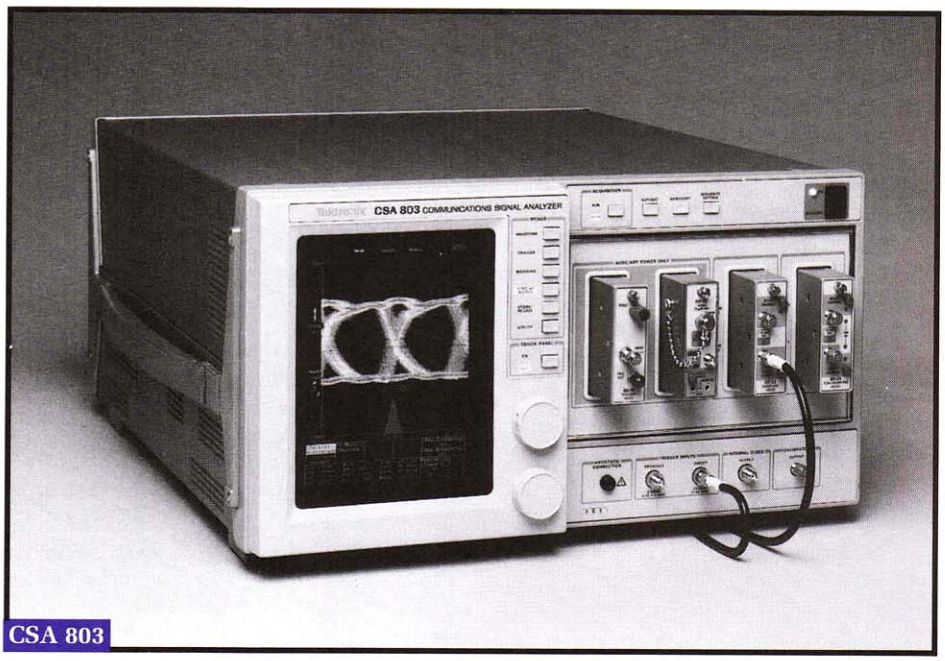
Specifically designed for communications applications, the CSA 803 Communications Signal Analyzer is the ideal tool for design, development, and production testing of telecommunications and data communications components, terminals, and systems.

CSA803

- High Resolution and Repeatability
- 8.8 ps Risetime
- Highest Sample Rate (200 kHz) among Sampling Oscilloscopes
- Modularity Through Sampling Heads.

APPLICATIONS

- Optical Standards Compliance Testing
- Electrical Standards Compliance Testing
- Timing Analysis
- Pass/fail Mask Measurements for Telecom (SDH/ SONET) and Datacomm (FDDI/ Fiberchannel)



CSA 803

CSA 803

The CSA 803 communications signal analyzer offers the highest bandwidth and time resolution of the 11000 Series. In addition to the easy-to-use, touch-screen user interface and powerful automatic measurement system common to all 11000 Series instruments, The CSA 803 adds single-ended and differential TDR and TDT, timing resolution to 0.01 ps, and up to 50 GHz bandwidth (depending on the sampling head used). This unmatched performance and feature set makes the unit ideal for semiconductor device testing. TDR characterization of circuit boards, IC packages, cables and high-speed digital communication measurements.

The CSA 803 accepts up to two, dual-channel SD Series sampling heads and has built in trigger capability of up to 10 GHz through the prescaler.

RESOLUTION AND REPEATABILITY

The state-of-the-art digital time base in the CSA 803 provides unmatched timing resolution, with sample intervals to 10 femtoseconds (0.01 ps) and measurement repeatability to 1 ps. In addition, the vertical system provides 8 bits of vertical resolution at all deflection factors (80 µV LSB at 2 mV/div). Powerful onboard waveform processing allows expansion with averaging to sensitivities in the 100 µV/div range and beyond.

FASTEST ACQUISITION

The CSA 803, with its multiprocessor-based architecture and high-speed analog, error-sample feedback-loop technology, has the highest sample rate of any sampling oscilloscope. The 200 kHz sampling rate gives the CSA 803 a "real-time" feel for waveform controls and allows high-speed data capture for histograms and automated measurements.

MODULARITY MAKES ROOM FOR GROWTH

In the Tektronix tradition, the CSA 803 can be tailored through modular plug-in sampling heads for a variety of applications. Modularity also offers a path for growth and expansion as new sampling heads become available. For example, for applications requiring superior noise performance, the SD-22 Sampling Head offers two channels of acquisition at 12.5 GHz with 450 µV (typical) of noise. High bandwidth acquisition and TDR are available in the SD-24 sampling head, which offers two channels with 20 GHz bandwidth and two polarity-selectable TDR step generators. The complete SD Series of sampling heads is listed on page 90-93.

STATISTICAL MEASUREMENTS

A built-in statistical database allows the instruments to accumulate three – dimensional waveform data-time, voltage, and *sample density*. The database is a 512x256x16 bit data array which accumulates waveform data by counting the number of times each pixel in the display is activated. This information is then displayed in a color-graded format that gives you an instant qualitative view of the acquired waveform. The power of the statistical database is the measurement capabilities - time and voltage histograms and automatic statistical measurements.

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

GPIB IEEE-488

The CSA 803 complies with IEEE Standard 488.1-1987, RS-232C and Tektronix Standard Codes and Formats.

Communications Signal Analyzer

COMMUNICATION APPLICATIONS USING THE STATISTICAL DATABASE

Time and voltage histograms are powerful statistical tools for measuring noise and jitter in communication signals. The histograms include useful information such as mean, rms deviation, and pk-pk displayed and continuously updated at a user selectable rate. High sample rates make it possible to analyze data concurrent with acquisition rather than in a batch mode later on. The statistical database allows you to change histogram parameters without reacquiring data.

For the first time you can make jitter and noise measurements with one simple selection from an on-screen menu. Controls are provided for adjusting left and right limits, selecting rms or pk-pk and absolute or relative measurements. For eye diagram measurements you can choose either the eye crossing or the mesial level for jitter measurement location. Either top line or base line can be selected for noise measurements. The CSA does the rest, and displays the jitter and noise measurements in the status menu at the bottom of the screen.

MASK TESTING

For tolerance testing in design or on the manufacturing floor, you can define and edit up to 10 masks simultaneously. These masks (polygons) may each have up to 50 vertices. The CSA then counts the individual and total samples that fall in each of the defined masks. It is an easy matter to define the masks for standards testing such as the FDDI pulse template or the SDH/SONET eye-pattern mask. This capability can easily be extended to other CCITT and ANSI standards which specify pulse templates or eye-pattern masks. Once defined the masks can be stored for future use.

AUTOMATED MEASUREMENTS MAKE IT EASY

The CSA 803 offers a comprehensive, accurate, and automatic measurement system. Up to six measurements can be displayed on screen at any time, all updated continuously. Any number of measurements may be made over the GPIB or RS-232-C interfaces.

For the first time in the industry, you now can make automatic jitter and noise measurements using the statistical measurement mode. Statistical measurements allow automatic pulse parameter measurements on random signals such as eye-diagrams and allow you to make stable and accurate measurements even in the presence of jitter and noise.

All measurement parameters are user-controllable and measurement levels may be set in relative (i.e., percentage) or absolute terms. Measurements are also fully annotated so there is no question about which part of the waveform is used for making the measurements.

Measurements include: amplitude measurements, such as mean, rms, p-p, and overshoot; timing measurements, such as width, propagation delay, and phase; and energy measurements, that provide direct area or energy results! Measurement statistics are also available to evaluate the stability of any measurement result.

ON-BOARD WAVEFORM PROCESSING

The extensive on-board waveform processing capability of the CSA 803 not only provides smooth "real-time" update rate and control response, it also allows complex waveform calculations to be performed and displayed in the same continuously updated fashion.

Calculated waveforms can be as simple as addition of two channels, or more complex, from basic operators (+, –, x, ÷), to specialized math functions such as square root, differentiate, log, envelope, and filter. Calculations can include acquired waveforms, stored waveforms, and constants.

All measurement functions, except hardware measurements, are allowed on calculated traces. In addition, the instrument can be set to stop acquisition after certain conditions, such as when a specified number of averages have been completed.

WINDOWING SHOWS THE DETAILS

The CSA 803 offers another first for sampling oscilloscopes – windows. Similar to the delayed sweep on conventional oscilloscopes, windows allow viewing a long interval on one trace while examining the details of a section of the waveform on a second trace.

Up to seven windows can be created on a single main trace, each with independent positions. The instrument can even be programmed to automatically locate a window on a specified transition within the main waveform. Like the other oscilloscopes in the 11000 Series, windows in the CSA 803 are actually re-acquired with a higher resolution than the main waveform – not just digitally expanded from the main trace, as in some lower performance instruments.

Continued on next page.

Communications Signal Analyzer

Characteristics

VERTICAL SYSTEM

Rise Time/Bandwidth – Determined by the sampling head used.*1

Vertical Resolution – 8 bits full screen (80 µV LSB at 2 mV/div deflection factor).

Amplifier Gain Accuracy – ±1% of all settings.

Deflection Factors – 2 to 255 mV/div in 1 mV/div increments.

Offset Range – ±2 V.

HORIZONTAL SYSTEM

Main and Window Time Base – 1 ps/div to 5 ms/div, settable in 1-2-5 sequence or in 1 ps increments.

TIME BASE ACCURACY*2

Time interval	Accuracy
≥ 10 ns	0.01% x time interval + 10 ps
1 ns	10 ps
100 ps	5 ps
10 ps	2 ps

Record Length – 512, 1024, 2048, 4096, and 5120 points.

Windows – Any number of window records may be placed on any number of main records, up to a maximum of 8 displayed traces. All window records have the same duration, but may be independently positioned on any main record. The window may be set to automatically track a moving edge on the main record.

Maximum Sample Rate – 200 kHz.

TRIGGER SYSTEM

Trigger Bandwidth – CSA 803: 2.5 GHz (direct), 2 to 10 GHz (Prescaled).

Trigger Sensitivity*3 – CSA 803: Direct: DC Coupled, 30 mVp-p, DC – 200 MHz; 200 MHz – 2.5 GHz increasing linearly to 250 mV; Prescaled: AC Coupled, 600 mVp-p, AC Coupled: Attenuates signals below 30 kHz, 40 mVp-p from 30 kHz to 200 MHz, 250 mVp-p at 2 GHz.

Delay Jitter – 2.5 ps +20 ppm of selected delay (rms).

Internal Clock – 100 kHz (drives TDR, Internal Clock Output, and Calibrator).

Trigger Input Range – ±1.5 V (direct), ±2.5 V (Prescaled).

MEASUREMENT SYSTEM

Waveform Processing Functions – Add, subtract, multiply, divide, absolute, average, differentiate, envelope, exponent, integrate, natural log, log, signum, square root, smoothing, and filter.

Measurement Set – Max, min, mid, p-p, mean, rms, amplitude, extinction ratio, overshoot, undershoot, noise*4, rise, fall, frequency, period, prop delay, cross, width, phase, duty cycle, jitter*4, area +, area –, and energy. Measurements are constantly updated; mean and standard deviation available on all measurements.

Measurement Parameters – Proximal, mesial, distal,and start/stop levels: May be set to relative or absolute values.

Cursors – Paired or split dots, vertical bars, and horizontal bars.

POWER REQUIREMENTS

Line-Voltage Ranges – 90 to 132 V rms, 180 to 250 V rms.

Line Frequency – 48 to 440 Hz.

Maximum Power Consumption – 214 W.

ENVIRONMENTAL AND SAFETY

Operating Temperature – 0°C to 50°C.

Non-Operating Temperature – –40°C to +75°C.

Altitude, Vibration, Shock, Bench Handling – Operating and Non-Operating: meets MIL-T-28800C, Type III, Class 5.

Safety – Listed UL 1244, CSA Bulletin 556B September 1973, Tektronix self-certification to comply with IEC 348 recommendation.

Electromagnetic Compatibility – Meets the following requirements of MIL-STD-461C: CE-03 Pt 4 Curve 1, CS-01 Pt 7, CS-02 Pt 4 CS-06 Pt 5, RE-02, Pt 7, RS-01 Pt 4, RS-02 Pt 5, RS-03 Pt 7, (limited to 1 GHz). Meets FCC Part 15, subpart J, Class A.

For Germany: Meets VDE 0871/6.78 Class B.

Humidity – To 95% RH at up to 50°C.

PHYSICAL CHARACTERISTICS

	Benchtop		Rackmount	
Dimensions	**mm**	**in.**	**mm**	**in.**
Width	448	17.6	483	19.0
Height	238	9.4	222	8.8
Depth	599	23.6	550	21.6
Weight ≈	**kg**	**lb**	**kg**	**lb**
Net	21.8	48	22.7	50
Shipping	31.3	69	32.3	71

**1 See Sampling Head Characteristics on page 92. The CSA 803 mainframe has no acquisition bandwidth limits.*
**2 Interpolate linearly between cardinal points.*
**3 CSA 803 has external trigger only; requires > 35 ns pretrigger or use of DL-11 Delay Lines to view trigger point.*
**4 Available only in statistical measurement mode.*

Communications Signal Analyzer

ORDERING INFORMATION

CSA 803

Communications Signal Analyzer **$25,150**

Includes: Tutorial manual (070-7718-00), User Reference (070-7719-00), Command Reference (070-7720-01), Programmer Reference (070-7738-01), Service Reference (070-7721-00), 12 inch SMA-SMA cable, 2 ea. 8 1/2 inch SMA-SMA cable, 1 wrist strap, Power Cord, U.S., Power Cord, U.S., 120 V (161-0066-00).

Opt. 1R – Rackmount ..... **+$250**

Opt. 10 – Deletes the 10 GHz prescalar trigger capability. This does not affect the 2.5 GHz trigger. ..... **–$1,000**

INTERNATIONAL POWER PLUG OPTIONS

Opt. A1 – Universal Euro 220 V, 50 Hz ..... **NC**

Opt. A2 – United Kingdom 240 V, 50 Hz ..... **NC**

Opt. A3 – Australian 240 V, 50 Hz ..... **NC**

Opt. A4 – North American 240 V, 60 Hz ..... **NC**

Opt. A5 – Switzerland 220 V, 50 Hz ..... **NC**

See General Customer Information Section for additional description.

WARRANTY-PLUS SERVICE OPTIONS

Opt. M7 – Calibration Service ..... **+$505**

Opt. M9 – Repair Protection ..... **+$1,010**

SOFTWARE

See Software Section for selection guide and complete description of software available.

PROBES

See Probe Selection Guide on page 423 for recommended probes.

ADDITIONAL ACCESSORIES

Cart – Order K220 ..... **$695**

Camera – Order C-9 with Opt. 1A and Opt. 11 ..... **$740**

Plotter – Order HC 100 ..... **$1,075**

CALIBRATION STEP GENERATOR

INTERNATIONAL POWER SUPPLY OPTIONS

Universal European – (240 V, 50 Hz). Order 067-1338-01 ..... **$5,490**

UK – (240 V, 50 Hz) Order 067-1338-02 ..... **$5,490**

Australia – (240 V, 50 Hz). Order 067-1338-03 ..... **$5,490**

Switzerland – (240 V, 50 Hz). Order 067-1338-05 ..... **$5,490**

Japan – (100 V, 50-60 Hz). Order 067-1338-06 ..... **$5,490**

ADDITIONAL ACCESSORIES

SMA Accessory Kit – Order 020-1693-00 ..... **$2,195**

Includes: 2 each 2X and 5X attenuators; 2 each SMA Terminations, Male Short Circuit, Female Short Circuit, Male 50 Ω, Female 50 Ω, 2 each 50 Ω Signal Cables (2 ns), 2 each 500 ps Semi-Rigid Cable, 2 each Male-to-Male adapters, 2 each SMA Male-to-BNC Female, 2 each Female-to-Female, 1 each 50 Ω Power Divider, 1 each Combination Wrench (.312, 6 point).

3.5 mm Accessory Kit – Order 020-1692-00 ..... **$6,595**

Includes: 1 each 50 Ω Reference Air Line, 1 each Male-to-Male Adapter, 1 each Female-to-Female Adapter, 1 each 26.5 GHz 50 Ω Terminator (Male), 1 each 26.5 GHz 50 Ω Terminator (Female), 1 each 26.5 GHz Short Circuit (Male), 1 each 26.5 GHz Short Circuit (Female), 2 each 50 Ω Terminators (6 dB 26.5 GHz, 2.9 mm), 2 each 50 Ω Terminators (20 dB 26.5 GHz, 2.9 mm), 1 each Power Divider (26.5 GHz, 2.9 mm), 2 each Signal blews (2 ns, Male-to-Male), 2 each Signal Cables (500 ps, Male-to-Male, 2.9 mm semi-rigid), 1 each Torque Wrench, 1 each Combination Wrench (0.312, 6 pint), 1 each Combination Wrench (0.281, 6 point).

2X Attenuator – SMA Male-to-Female. Order 015-1001-00 ..... **$185**

5X Attenuator – SMA Male-to-Female. Order 015-1002-00 ..... **$175**

Power Divider – Order 015-1014-00 ..... **$300**

Blank Sampling Head – Order 200-3395-00 ..... **$0.85**

ECL Terminator – Provides the bias and termination for ECL device outputs. At 10 GHz bandwidth and 1% precision attenuation, accurate AC and DC measurements are ensured.
Attenuation: 10X ± 1.0% @ DC, 20 dB ± 3 dB, DC to 10 GHz.
Aberrations: ±3% max with 100 ps rise time.
Order 015-0558-00 ..... **$910**

DC Block (Coupling Capacitor) – Order 015-1013-00 ..... **$315**

Slip-On Connector – Order 015-0553-00 ..... **$38**

Connector Savers – SMA: Order 015-0549-00 ..... **$185**
APC: Order 015-0552-00 ..... **$245**

CABLES AND EXTENDERS

Sampling Head Extender Cables – (1 m). Order 012-1220-00 ..... **$710**
(2 m). Order 012-1221-00 ..... **$735**

Acquisition Extender – Order 067-1324-00 ..... **$105**

Card Cage Extender – Order 067-1267-00 ..... **$895**

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

GPIB IEEE-488

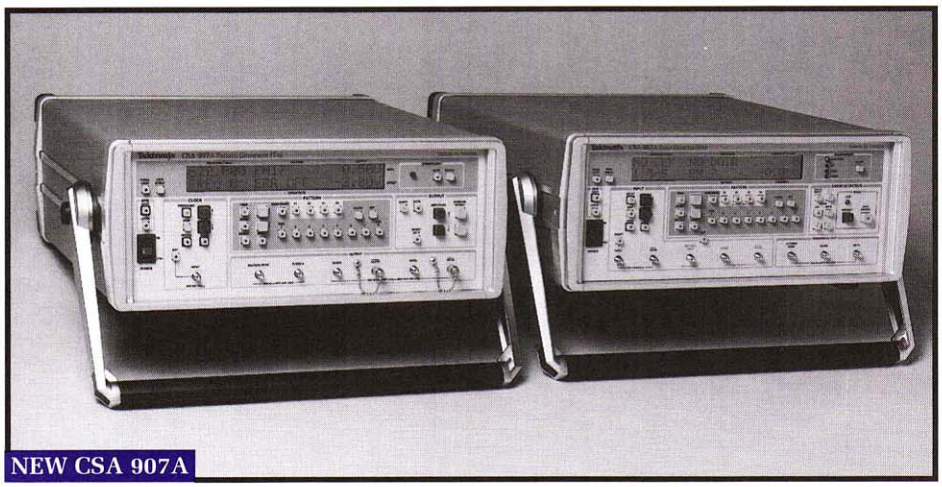
The CSA 803 complies with IEEE Standard 488.1-1987, and with Tektronix Standard Codes and Formats.

Bit Error Rate Tester

FDDI, SDH, SONET Pattern Generation

CSA 907A

- SDH/SONET and FDDI pattern generation
- 150 KHz to 700 MHz internal PLL clock source
- PRBS patterns: $2^{(7,15,17,20,23)}$ -1
- Optional 128K bit programmable word memory
- PC based frame editing software for added versatility
- Error injection: single errors, selectable error rate, or gated errors
- Differential and single ended inputs
- External reference data input for user generated patterns
- Automatic data/clock setup
- Versatile Bit Error Rate measurements and analysis
- Centronics, RS-232 and GPIB (IEEE-488.2) remote interfaces
- ECL, PECL and programmable voltage levels



NEW CSA 907A

CSA 907A

The CSA 907A Bit Error Rate Tester is a stimulus-response system that features a high-speed serial pattern generator, the CSA 907A TX, and a companion error detector, the CSA 907A Rx. Each unit is portable, and can be used in a lab, production testing, or field environment. The CSA 907A Bit Error Rate Tester can be used to evaluate transmission quality of high speed modules and systems for a variety of testing applications including SDH/SONET, FDDI, and satellite communications.

Along with the CSA 803 Communications Signal Analyzer, and a full line of optical test products, a complete SDH/SONET/FDDI Standards Test System is formed to verify compliance to physical layer standards for bit error rate, noise, jitter, and mask templates. See page 224 for more information.

DATA PATTERN GENERATION

Pseudo Random Bit Sequence patterns (PRBS) simulate real data and are important in order to make statistical measurements such as error rate, jitter and noise on communication devices, modules and systems. The CSA 907A Tx has the ability to generate five PRBS patterns that include $2^{(7,15,17,20,23)}$ -1. In addition, single errors, a programmed error rate , or burst errors can be transmitted in the data stream for continuity checks and system stress evaluation. In addition to the PRBS patterns, the CSA 907A features ten 16 bit programmable words.

FDDI/SDH/SONET PATTERN GENERATION

For long word lengths, the Framewriter software package, together with an 128K extended memory option provide the tools to make application specific or user defined patterns. Applications include the ability to send 20 contiguous STS-1 patterns, up to 6 contiguous STM-1/STS-3c patterns, or a single STM-4/STS-12c pattern. To insure test repeatability, the extended memory option also features 10 fixed ROM based patterns:

- FDDI: 4B/5B NRZ pattern, 4B/5B NRZ-I pattern
- SDH: STM-1 pattern, STM-1 scrambled pattern
- SONET: STS-1 pattern, STS-1 scrambled pattern, 4 STS-1 patterns, 4 STS-1 scrambled patterns, STS-3 pattern, STS-3 scrambled pattern

DATA PATTERN EDITING SOFTWARE

A menu driven IBM-PC compatible software package, "FrameWriter™", is provided with the CSA 907A. FDDI, and SDH/SONET patterns are easily created and edited on a computer or controller external to the CSA 907A, and then down-loaded to the CSA 907A through the GPIB interface. These signal frames can then be quickly and reliably recalled with a single front panel button on the CSA 907A or recalled automatically under program control.

VERSATILE CLOCKING SOURCES

The CSA 907A has an internal PLL clock source that transmits patterns at speeds of 150 KHz to 700 MHz, thereby eliminating the need for an external clock synthesizer. The clock source has a resolution of 1 KHz and 10 ppm stability. This extra resolution is especially important in:

- SDH/SONET applications where frequencies are allocated in increments of 10KHz
- Testing a clock recovery circuit where the user wants to sweep across the bandpass of the PLL to check lock-in and hold ranges.

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

GPIB IEEE-488 — The CSA907A complies with IEEE Standard 488.2-1987, and with Tektronix Standard Codes and Formats.

Bit Error Rate Tester

CSA 907A

Ten commonly used frequencies can be stored and later recalled for repeatability and standards compliance testing. For applications where the test is to be performed using a known reference clock, the CSA 907A Tx has the ability to accept an external clock input. The external clock input can be used to inject jitter in conjunction with an external signal generator.

The CSA 907A Tx external clock input is conditioned to accept a clock burst, and output a pattern with periods of no data (burst mode). The CSA 907A Rx can recognize the pattern with periods of no data without losing synchronization. The burst mode simulates communication and telemetry systems that often send data in "bursts" with variable times of inactivity between bursts.

AUTO SET AND SYNC
The CSA 907A "auto-set" synchronization feature allows effortless system setup and operation. The "auto-set and sync" feature simplifies adjusting multiple input parameters by providing automatic clock /data threshold level, clock to data phase adjustment, appropriate data pattern selection (and polarity), and bit synchronization to data patterns. These powerful automatic synchronization features allow the user to immediately perform a wide range of tests on systems and components.

VERSATILE MEASUREMENT AND ANALYSIS
The CSA 907A allows a wide range of concurrent Bit Error Rate measurements and analysis for fully characterizing and testing communication devices, subsystems, and links. In addition to total errors and error rate, the Error Detector measures errors in a programmable time, bit length, or sliding window. Report printouts are available both at end-of-test, and when exceeding a user defined error threshold.

EXTERNAL REFERENCE DATA
The external data reference mode in the CSA 907A allows the user to measure and analyze transmission errors for virtually any user generated data pattern. It is useful when evaluating the performance of a component or system against a user supplied reference data. Delay compensation up to 4 nanoseconds, data threshold adjust, and input termination voltage selection is also possible with the external reference data input.

OPERATIONAL SUPPORT
For test repeatability and programmed control, the CSA 907A supports both RS-232 and IEEE-488.2 GPIB (with Tektronix Standard Codes & Formats) remote interfaces. The battery backed-up non-volatile RAM memory provides storage of ten 16 bit word patterns, eight 128K bit word patterns (optional), 10 clock frequencies, error measurements and unit setup for loss of power conditions. The Error Detector provides monitor outputs for viewing eye diagrams on the CSA 803 and CSA 404 Communication Signal Analyzers. The rear panel has specialized inputs and outputs for customized data generation and BER measurements.

Characteristics

CSA 907A TX PATTERN GENERATOR
Frequency Range: – 150 KHz to 700 MHz (Mbit/s) with internal or external clock.

Resolution – 1 KHz with 10 ppm stability.

Frequency Memory – 10 frequencies.

External Clock Input – Selectable termination: (50 Ω to GND, or 50 Ω to –2 V) DC coupled, 1.4 Vp-p.

Data Output Formats – NRZ, Normal and complement; PRBS patterns and programmable WORD.

PRBS Patterns – $2^{(7,15,17,20,\text{or } 23)}-1$.

Maximum WORD Length – 16 bits (128K pattern memory optional).

WORD Memories – 10 x 16 bits (8 x 128K bits optional).

Data and Clock Outputs – 50 Ω true and complement (differential); Amplitude: 500 mVp-p to 2 Vp-p into 50 Ω; Baseline Offset: –2.0 V to +1.8 V (50 Ω to GND), –3.0 V to +0.8 V (50 Ω to –2 V), –0.5 V to 3.3 V (50 Ω to +3 V); Rise/Fall Times: 200 ps, typical @ 1 Vp-p.

Internal Error Injection – $1 \times 10^{-3, 4, 5, 6 \text{ or } 7}$ rate.

External Error Injection – 1 error injected for each rising edge, ECL.

Auxiliary Outputs – Clock/4 and pattern sync; 500 mVp-p into 50 Ω centered to GND.

CSA 907A RX ERROR DETECTOR
Frequency Range – Clock Input: 150 KHz to 700 MHz; Data Input: 150 Kbit/s to 700 Mbit/s.

Error Measurements and Analysis – Measurements: BER, total errors; Sliding BER Window: *Time* - 1 second to 24 hours, *Bits* - 1 x 108 to 1 x 1016; Error Analysis: Error Seconds, Error Free Seconds, Severely Error Seconds, Degraded Minutes, Unavailable Seconds, Loss Of Signal, Threshold Error Seconds.

Clock, Data and Data Reference Inputs – NRZ, RZ, Normal and complement (data only); Input Threshold: –2 V to + 4 V (50 Ω to GND), –3 V to + 3 V (50 Ω to –2 V), –1.5 V to + 4.5 V (50 Ω to + 3 V); Input Amplitude: 0.5 to 6.0 Vp-p; Impedance: 50 Ω, selectable terminations (GND, –2 V, +3 V, or floating); Delay Range: 0 to 4 ns, variable.

Monitor Outputs – Pattern sync, clock, data, and error; DC coupled, 500 mVp-p centered on GND.

CSA 907A TX/CSA 907A RX GENERAL SPECIFICATIONS
Front Panel Connectors – SMA female.

Power Requirements – 90 to 132 VAC, or 180 to 264 VAC, 47 to 63 Hz, 100 VA max.

Operating Temperature – 0 to 50° C.

EMI – Complies with FCC A and VDE B specifications.

PHYSICAL CHARACTERISTICS

Dimensions	mm	in.
Width	366	14.4
Height	152	6
Depth	340	13.4
Weight ≈	**kg**	**lb**
Net	10.9	24

ORDERING INFORMATION

CSA 907A
Bit Error Rate Tester **$36,990**

Includes: Pattern Generator, Error Detector, CSA 907A User Manual (P/N 070-8685-00), CSA 907A Programmer Manual (P/N 070-8686-00),"FrameWriter" IBM-PC compatible software frame editing package.

INSTRUMENT OPTIONS
Opt. 1R – Rackmount ..... **+$590**
Opt. 5D – 75 Ω termination ..... **+$1,995**
Opt 6D – 128K Ext. Patt. Memory (Tx & Rx) ..... **+$13,000**
Opt 7D – 128K Ext. Patt. Memory (Tx) ..... **+$6,500**
Opt. 8D – 128K Ext. Patt. Memory (Rx) ..... **+$6,500**
Opt. 9R – Delete Error Detector ..... **–$13,000**
Opt. 9T – Delete Pattern Generator ..... **–$15,000**
Opt. 94 – Statement of Conformance ..... **N/C**

INTERNATIONAL POWER PLUG OPTIONS
Opt. A1-A5 – Available. See General Customer Information Section for additional description.
Plotter – Order HC100 with Opt. 01 ..... **$1,180**
Cart – Order K218 ..... **$695**

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

GPIB IEEE-488 — The CSA 907A complies with IEEE Standard 488.2-1987, and with Tektronix Standard Codes and Formats.

Digital Signal Processing System

Real Time Input Bandwidth of 10 MHz

3052

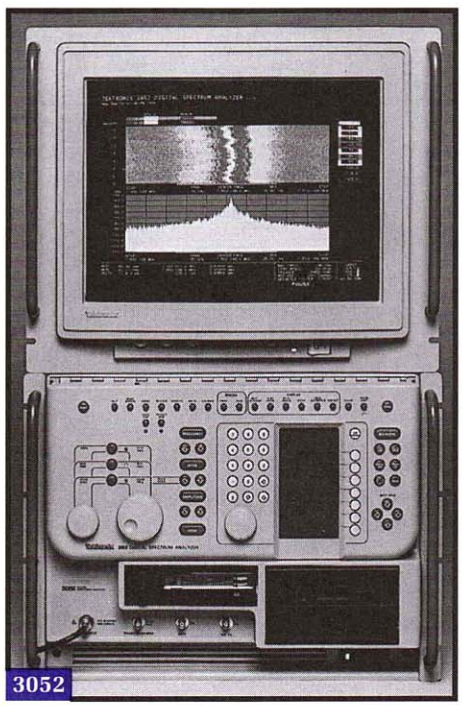
- Communications
- Signal Analysis
- Radar Signal Processing

BENEFITS

- Wide Real Time Bandwidth Captures Elusive Transients
- Digital Interface Transfers Data Quickly (Opt. 10)
- System Flexibility Using Industry Standards

FEATURES

- Spans from 1 kHz to 10 MHz with Center Frequency Tunable Across the DC to 10 MHz Range, 100 Hz to 10 MHz, optional
- Trigger and Capture 500 Sequential Spectrums at Real Time Rates and Scroll the Captured Block
- Triggering Capabilities, Including Optional Spectral Event Triggering
- Can be Used with Receivers on Carrier Signals up to 325 GHz



3052 DSP System

The Tektronix 3052 Digital Signal Processing System performs real-time spectral analysis at wider frequency spans. With 10 MHz real-time input, and 2 MHz real-time output spans, the 3052 updates its spectral output every 200 µs. The 3052 offers solutions to difficult analysis and measurement problems.

Spectral frames are output from a digitally implemented bank of 1024 parallel band-pass filters. The output of each filter consists of both real and imaginary data components.

FILTER BANK

The shape of each filter and data output rates are key to several of the 3052's performance characteristics: frequency flatness, amplitude accuracy, spectral resolution, dynamic range, sensitivity, and the suitability of its digital output for post processing.

The center frequency of the filter bank is tunable, enabling any frequency within the instrument's 10 MHz timing range to be viewed at narrow spans.

The filters are reconfigurable, which allows the user to tailor the analysis characteristics to particular needs.

DISPLAY

The 3052 features a high resolution, 16-inch color monitor that displays 801 frequency bins.*[1] Display formats include power versus frequency, phase versus frequency, Spectrogram, and Waterfall. One display can occupy the full screen or two displays can be presented on a split screen.

KEY BOARD

Knobs provide quick operation and basic spectrum analyzer control. In addition, a liquid crystal display presents menus of more extensive functions and prompts the entry of parameters. The keyboard is detachable for flexibility in positioning and handling.

BLOCK CAPTURE MODE

Blocks of 500 sequential spectral frames are captured in memory and transferred to the monitor for Spectrogram display. With this mode and the optional spectral event triggering, a user may trigger on a spectral event, capture a block of 500 sequential frames, then scroll back to examine the contents of the block frame-by-frame.

SYSTEM ARCHITECTURE AND SOFTWARE

The system architecture is based on the VMEbus. Cards comprising the main part of the instrument are "pipelined" to a stage that interfaces with the standard VMEbus. The instrument software operates under the SYSTEM V/68™ version of UNIX™. Instrument controls and functions are implemented in C language and card-modular firmware. Programmers have access to selected UNIX and C libraries for the development of application programs via RS-232 port. Individual spectrums, blocks of spectrums, instrument setups, and keystroke macros can be stored on disk for later call up for display or off-line processing by stored programs. Stored programs can be executed from the keyboard.

REAL TIME INTERFACE (OPTION 10)

An optional interface provides access to real time spectral data output; 32 bit spectral data is divided into two parts, available at two separate RS-422 connectors. Option 10 also provides a Spectral Event Detection Output; two spectral limit masks may be implemented; a maximum and a minimum. When the spectral output falls outside one of these limits, a TTL Low accompanies the data to identify the spectral frame and bin. Analog outputs to drive an oscillographic recorder, an x-y monitor, or an oscilloscope are provided as part of Option 10.

**[1] A bin is a hardware storage location for the complex data output of each filter in the bank. Each spectral frame is comprised of the parallel outputs from the 1,024 bins. The central 801 bins are displayed, covering the selected span of the 3052. A bin width is considered to be 1/800th of the displayed span.*

SYSTEM V/68™ is a trademark of Motorola, Inc.

UNIX™ is a trademark of AT&T.

To order, contact your local sales office (listed on the inside back cover).

GPIB IEEE-488 — The 3052 Option 02 complies with IEEE Standard 488.1-1987, and with Tektronix Standard Codes and Formats.

Digital Signal Processing System

Characteristics

FREQUENCY RELATED

Range – DC to 10 MHz.

Span – 1 kHz to 10 MHz in a 1-2-5 sequence, 100 Hz to 10 MHz optional.

Shape Factor – Ratio of FIR Filter 3 dB to 60 dB bandwidth: 1.7:1.

Displayed Bins – 801 for all spans.

Center Frequency Accuracy – $\pm CF \times 10^{-7}$.

Signal Resolution With Standard Filter – ≤3 bin widths (also holds for one signal at Reference Level and the other at ≤70 dBc).

10 MHz Standard Drift – 1×10^{-9}/day and 1×10^{-7}/year.

AMPLITUDE RELATED

Reference Level Range – +33 to –140 dBm.

Accuracy – ±0.2 dB at 12.5 kHz, 0.5 dB at all other frequencies with error correction.

Flatness Across Span – ±0.85 dB normalized to 12.5 kHz, ±0.33 dB with error correction.

Display Dynamic Range – 84 dB.

A/D Converter – 25.6 megasamples/per second, 10 bits.

Maximum Input Range – +33 to –57 dBm (signals above the Maximum Input Level are clipped by the A/D Converter).

Harmonic Distortion (with signal 6 dB below maximum input) – DC to 1 MHz: –65 dBc/; 1 to 10 MHz: –58 dBc.

IM Distortion (2nd and 3rd Order with two signals 6 dB Below maximum input) – DC to 1 MHz: 65 dBc/; 1 to 10 MHz: 60 dBc.

Residual Responses – 70 dB below maximum input.

SPAN RELATED CHARACTERISTICS

Span	Bin Width/ Resolution Passband (0.05 dB Bandwidth)	Spectral Frame Internal	Spectral Frame Rate	Spectral Frame Rate/ Resolution Passband	Sensitivity @ 2 MHz dBm	dBv	dBmV
10 MHz	12.5 kHz	200 µs	5 kHz	0.4	–107	–120	–60
5 MHz	6.25 kHz	200 µs	5 kHz	0.8	–110	–123	–63
2 MHz	2.50 kHz	200 µs	5 kHz	2.0	–114	–127	–67
2 MHz	1.25 kHz	200 µs	5 kHz	4.0	–117	–130	–70
500 kHz	625 Hz	200 µs	5 kHz	8.0	–120	–133	–73
200 kHz	250 Hz	1 ms	1 kHz	4.0	–124	–137	–77
100 kHz	125 Hz	1 ms	1 kHz	8.0	–127	–140	–80
50 kHz	62.5 Hz	1 ms	1 kHz	16.0	–130	–143	–83
20 kHz	25 Hz	5 ms	200 Hz	8.0	–134	–147	–87
10 kHz	12.5 Hz	5 ms	200 Hz	16.0	–137	–150	–90
5 kHz	6.25 Hz	5 ms	200 Hz	32.0	–140	–153	–93
2 kHz	2.5 Hz	25 ms	40 Hz	16.0	–144	–157	–97
1 kHz	1.25 Hz	25 ms	40 Hz	32.0	–147	–160	–100
Opt. 06							
500 Hz	0.625 Hz	50 ms	20 Hz	32.0	–150	–163	–103
200 Hz	0.250 Hz	250 ms	4 Hz	16.0	–150	–163	–103
100 Hz	0.125 Hz	250 ms	4 Hz	32.0	–150	–163	–103

When the value of the Spectral Frame Rate divided by the Resolution Passband is equal to or greater than 2, the spectral output has a real time sample rate.

DISPLAY RELATED

Display Operation – Full and split screen depiction.

Display Modes – Amplitude vs Frequency, Phase vs Frequency, Spectrogram, and Waterfall.

Display Formats – Average, Min/Max, Peak, Rth, Block Capture.

Vertical Display – 1, 2, 5, or 10 dB/div, 1-15 dB/div keyboard definable, and Linear.

Display Range – 10 divisions.

DISPLAY MONITOR

Pixel Resolution – 1024 by 768.

Refresh Rate – 60 Hz noninterlaced.

Displayable Colors – 256 concurrent.

Size – 16 inch diagonal.

SIGNAL INPUT

Signal Input – AC and DC: AC has 3 dB roll-off at 10 Hz.

Impedance – 5 Ω, 1 MΩ.

Maximum Rated Input – 5 Ω: 5 Vrms (+27 dBm), 1 MΩ: 500 VDC, 17 Vrms (+25 dBv).

Digital Signal Processing System

INPUT TRIGGERING AND ACQUISITION START/STOP

Sources – Internal, External, Line, Free Run.

Modes – Single, continuous, start.

INPUT/OUTPUT

Contact a Tektronix Field Representative for detailed information.

CLOCK

Internal Reference – 10 MHz Frequency Drift: 1 x 10^{-9} per day and ≤1 x 10^{-7} per year.

External Reference – 1 MHz: ±200 Hz. 5 MHz: ±1 kHz. 10 MHz: ±2 kHz.

POWER REQUIREMENTS

Line Frequency – 50 Hz.

Line Voltage – 100 VAC to 132 VAC; 200 VAC to 250 VAC.

Input Power – Instrument chassis with keyboard and Monitor: 1150 watts maximum, 950 watts typical.

ENVIRONMENTAL

Altitude – Operating: 10,000 ft. Nonoperating: 15,000 ft.

Temperature – Operating: 10°C to 40°C. Nonoperating: –20°C to + 60°C.

Relative Humidity – Noncondensing, Operating and Nonoperating: 5 to 95% over a temperature range of 10°C to 30°C.

Shock – Operating: 10 G (except disks: 5 G). Nonoperating: 10 G.

Vibration – Except disks, operating and nonoperating, 5 Hz to 55 Hz; y- and z-axes, 2 G; x-axis, 1 G.

EMI – Complies with VDE 0871 Class B.

MILITARY SPECIFICATION

Specified to MIL T-28800D, Type III, Style E (or F), with exceptions.

PHYSICAL CHARACTERISTICS

Dimensions	mm	in.
Width	483	18.75
Height	756	29.75
Depth	629	24.75
Weight	**kg**	**lb**
Net	95	210

ORDERING INFORMATION

3052

Digital Signal Processing System **$99,500**

Includes: Operator's Manual, Programmer's Manual, Operator's Guide and Assembly Level Service Manual.

Opt. 02 – Instrument Controller Capability. Includes: VME-to-GPIB interface board and software for GPIB (IEEE 4.88.2) talker, listener and controller functions. Includes GPIB Interface Cable ..... **+$2,995**

Opt. 06 – Resolution Enhancement to 0.125 Hz ..... **+$8,950**

Adds the following narrower spans and resolution passbands:

Span	Resolution Passband
500 Hz	0.625 Hz
200 Hz	0.250 Hz
100 Hz	0.125 Hz

Opt. 10 – Real Time Interface ..... **+$9,950**

Output Connectors: Located at rear of instrument chassis on board panel.

Real time Data Output: Two RS422 connectors operating in parallel with 5.12 MHz maximum clock rate. 16 bit component of complex spectral data on each connector. Event detection included on control line.

Event Detection: BNC connector. TTL levels.

Analog Display Outputs: Three BNC connectors, with signals to drive 608 monitor, oscilloscope and oscillographic recorder.

Opt. 11 – Tektronix RGB Series and 469xDX Series Color Printer Interfaces. Enables the PRINT SCREEN function and provides interface cable for RGB-Series Printers, and provides driver software for 469xDX Series Printers ..... **+$1,495**

Opt. 14 – Streaming Tape Drive. Adds Archive streaming tape drive and one blank 3M DC-600A, 150 MByte tape cartridge. Drive is installed in Expansion Bay (replaces floppy drive if User Bay is occupied by a hard disk drive). ..... **+$2,495**

Additional Blank Tape Cartridges – Box of 5. Order 119-1463-01 ..... **$350**

Opt. 15 – Removable System Drive. Adds mechanisms for easy removal and insertion of system hard drive ..... **+$1,100**

Opt. 16 – 170 MByte System Drive. Replaces the standard 100 MByte system drive with a 170 MByte hard disk drive. Compatible with Opt. 15 ..... **+$1,895**

Opt. 22 – 170 MByte User Drive. Adds hard disk drive for storage of user data and programs. Displaces floppy drive to Expansion Bay ..... **+$1,995**

Opt. 30 – Removable 170 MByte User Drive. Same disk capacity as with Opt. 22. Mechanisms added to remove and insert hard disk drive ..... **+$3,095**

SUMMARY OF DRIVE OPTION BY BAY

(No more than one drive per bay)

Bay	Disk Drive	Option
User	Floppy Disk Drive	Std
	170 MB Fixed Hard Disk	22
	170 MB Removable Hard Disk Drive	30
System	100 MB Fixed Hard Disk	Std
	100 MB Removable Hard Disk Drive	15
	170 MB Fixed Hard Disk	16
	170 MB Removable Hard Disk	15, 16
Expansion	Empty	Std
	Floppy Disk Drive	*
	Streaming Tape Drive	14

**The floppy disk drive is moved from the user bay to expansion bay when Opt. 22 or 30 is installed. When the floppy disk drive has been so displaced, and then Opt. 14 is installed, the floppy disk drive is deleted.*

Opt. Q0 – Installation ..... **+$350**

Opt. Q1 – N/A

Opt. Q2 – Warranty-Plus 21 Additional Months of Service ..... **+$11,025**

Opt. Q3 – Warranty-Plus 33 Additional Months of Service ..... **+$17,325**

Opt. Q9 – Nine Months of Software Subscription Service ..... **+$2,365**

Opt. 1N – The standard product includes Opt. Q1, Warranty-Plus, on-site service to supplement the 90-day warranty period with an additional 9 months of warranty-like service. Opt. 1N deletes this nine-months supplement ..... **–$4,000**

INTERNATIONAL POWER PLUG OPTIONS

Opt. A1 – Universal Euro 220 V/16A, 50 Hz ..... **NC**

Opt. A2 – UK 240 V/13A, 50 Hz ..... **NC**

Opt. A3 – Australian 240 V/10A, 50 Hz ..... **NC**

SOFTWARE

S2MG100 – Enhanced Frequency Measurements **$5,000**

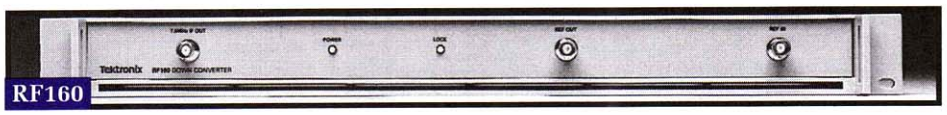
Opt. 01 – Floppy Diskette. ..... **NC**

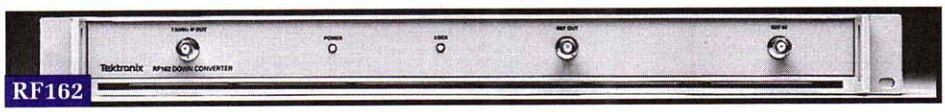
Opt. 02 – Streaming Tape Cartridge. ..... **NC**

To order, contact your local sales office (listed on the inside back cover).

GPIB IEEE-488 — The 3052 Opt. 02 complies with IEEE Standard 488. 1-1987, and with Tektronix Standard Codes and Formats.

Down Converters





RF160 and RF162 Down Converters

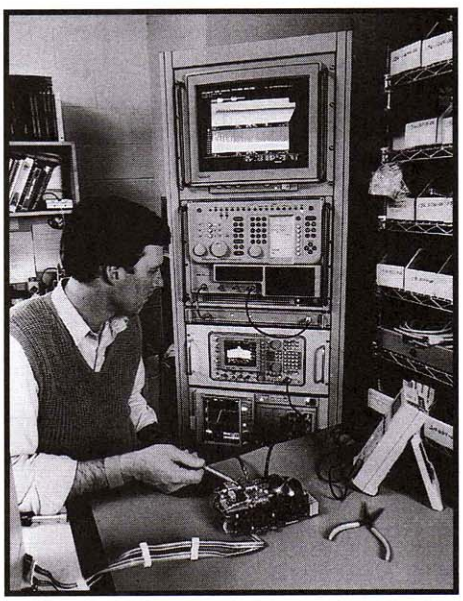
The RF160 Down Converter is a means of combining the signal analysis capability of the 3052 Digital Signal Processing System with common receivers and Tektronix spectrum analyzers, such as the 2780 and 2790 Series. Housed in a rugged rackmountable module, the Down Converter is designed to be mounted below the 3052.

The RF160 works by taking the Intermediate Frequency (IF) output from a receiver or Tektronix spectrum analyzer, and mixing the signal to the analysis range of the 3052. The full capabilities of the 3052, at spans of 5 MHz and narrower, may then be used to analyze the signal. A microwave signal ranging up to 40 GHz in coax, or 325 GHz using waveguide mixers (Tektronix analyzers), may be fully examined.

A typical application makes use of the 2784 Spectrum Analyzer, RF160 Down Converter, and a 3052 Digital Signal Processing System to analyze a microwave signal with a 38 GHz carrier. By tuning the 2784 to the carrier frequency, and applying its wideband IF output, the RF160 down converts the carrier to the analysis range of the 3052. The 3052 (with Option 10) may then be employed to compare the incoming signals against spectral event detection masks–alerting the user to the presence, absence, or changing amplitude of the signal.

The companion software product S2MG160 offers special control functions to simplify applications. The S2MG160 supports applications with the Tektronix 2780 and 2790 Series Microwave Analyzers. This product allows users to tune these analyzers remotely from the 3052 front panel, and facilitate fully integrated operation.

The RF162 operates on the same principal as the RF160, except that it operates on the military IF frequency of 21.4 MHz, and optionally at 321.4 MHz. It permits users to redeploy existing spectrum analyzers and receivers with new 3052 Digital Signal Processing Systems to develop high-powered analysis systems.



The RF160 Down Converter depicted in a measurement system. In this case a microwave carrier signal is applied to a Tektronix 2782 Option 04 Spectrum Analyzer. The IF output of the analyzer is then down converted by the RF160, effectively extending the analysis range of the 3052.

Continued on next page.

RF160/ RF162

- Wide-Band Spur Searches on Radar Systems
- RF Signal Monitoring and Analysis
- Manufacturing ATE

FEATURES

- Works with Tektronix 2780- and 2790-Series Spectrum Analyzers
- Accepts 160, 110, or 25 MHz/21.4 or 321.4 MHz Wide Band IF Signals from Tektronix RF Spectrum Analyzers and Popular Receivers
- Down Converts IF Signals for 3D Modulation Analysis on the Tektronix 3052 Digital Signal Processing System
- Effective Component in Complex Processing Systems

Intermediate frequency down converters enable realtime spectral analysis of IF signals to be done on the 3052 DSP System.

To order, contact your local sales office (listed on the inside back cover).

Down Converters

Characteristics

INPUT SIGNALS

Acceptable IF Frequencies – RF160: Standard is 160 MHz, 110 MHz; Opt. 25 is 25 MHz. RF162: Standard is 21.4 MHz; Opt. 03 is 321.4 MHz.

SIGNAL INPUT (50 Ω Rear Panel Connector)

Optimum Input Power – RF160: –30 dBm. RF162: Standard is –36 dBm; Opt. 03 is –30 dBm.

Maximum Input Level Without Damage – +20 dBm.

FREQUENCY RELATED

Flatness – 1 dB p-p across the 5 MHz to 10 MHz output range. Excludes host analyzer flatness.

AMPLITUDE RELATED

Third Order Intermodulation Distortion – –70 dBc for two input signals at –36 dBm. Specifications exclude host analyzer distortion.

Harmonic Distortion – –70 dBc for a single tone at nominal input power.

Other Single Tone Spurious Responses – –80 dBc below any single input signal within the nominal input frequency range.

Residual Responses (5 MHz to 10 MHz with No Input Signal) – –110 dBm at the output.

Noise Figure – Standard: 15 dB. Opt. 25: 9 dB.

REFERENCE INPUT

Rear Panel Connectors – Two BNC 50 Ω inputs direct coupled to each other and AC coupled to the RF160, or RF162 circuitry. Reference applied to one connector at a time only. Required input power is –10 to +20 dBm, or TTL. Required frequency accuracy is 10 MHz ±2 PPM.

OUTPUT SIGNALS

7.5 MHz IF Output – 50 Ω BNC connector located on the front panel. Nominal output power is –20 dBm.

Maximum Reverse Power Without Damage – +22 dBm.

REFERENCE OUTPUT

Front and Rear Panel Connector – 50 Ω TTL level with independent 50 Ω terminations.

POWER REQUIREMENTS

Line Frequency – 50 Hz.

Line Voltage – 90 to 132 VAC; 180 to 264 VAC.

Input Power – Operating power is 16 W (25 W maximum). Operating current is typically 0.25 A, 0.42 A maximum.

ENVIRONMENTAL

Altitude – Operating: 20,000 ft. Nonoperating: 40,000 ft.

Temperature – Operating: 0°C to 50°C. Nonoperating: –20°C to +60°C.

Relative Humidity – Operating is 90%. Nonoperating is 95%.

Relative Humidity – Noncondensing: 5 to 95% over a temperature range of 10°C to 30°C.

Shock – Operating and Nonoperating: 50 G.

Vibration – Operating: 2 G, 5 to 55 Hz.

EMI – Complies with FCC and VDE requirements.

PHYSICAL CHARACTERISTICS

Dimensions	mm	in.
Width	425.5	16.75
Height	44.5	1.75
Depth	527	20.75
Weight	**kg**	**lb**
Net	4.2	9.25

ORDERING INFORMATION

RF160
Down Converter (Standard 160, 110 MHz IF Input) **$9,950**
Includes: Instruction and Service Manual.
Opt. 25 – 25 MHz IF input exclusively ..... **NC**
RF162 Down Converter – (Standard 21.4 MHz IF input)
Includes Instruction and Service Manual **$9,950**
Opt. 03 – 321.4 MHz IF input ..... **+$1,950**

INTERNATIONAL POWER PLUG OPTIONS
Opt. A1 – Universal Euro 220 V/16A, 50 Hz ..... **NC**
Opt. A2 – UK 240 V/13A, 50 Hz ..... **NC**
Opt. A3 – Australian 240 V/10A, 50 Hz ..... **NC**

WARRANTY
One Year parts and labor.

MAINTENANCE
Calibration Period – 1 year.
Service Support – Component Level Repair at Tektronix designated service centers.

To order, contact your local sales office (listed on the inside back cover).

Systems/Controllers/ Software

Unlimited Flexibility in System Solutions

The Tektronix Open Measurement Environment helps you put together the ideal test-and-measurement solution for your needs. It allows you to choose products from a wide range of manufacturers of test-and-measurement technology, with confidence that all the components will work together. You can use the ideal computer hardware, the perfect software package, and the specific instruments that best suit your application.

Single-supplier, closed architectures limit your choices. With the Open Measurement Environment, they're practically unlimited.

Instrument Controllers and Interfaces

Tektronix offers a suite of controllers, interface hardware and software for automated instrumentation control. Whether the test requirement calls for GPIB, VXIbus, or a combination thereof, Tektronix can provide a powerful, cost-effective controller or interface perfectly matched to your needs.

System Software

As with its system hardware offerings, Tektronix strives to provide the most flexible, advanced software solutions for test program development.

The Right Choice

Certainly no single architecture will be right for all users. Whatever your hardware or software platform, your operating system, networking, or program development environment, Tektronix is ready to solve your test problem with a powerful *open* solution. And, as with all its products, Tektronix guarantees uniform quality, compatibility, and long-term support on a global scale.

CONTENTS

SYSTEMS

Open Measurement Environment.....262
Standard Platforms.....264
Configured Solutions.....265
Tektronix Integration Center.....267
System Instruments.....268
Controllers.....272
System Software.....274
Instrument Software.....277

The Open Measurement Environment

Ideal test and measurement solutions.

Open systems architecture gives you the means to create an uncompromised system solution for your most challenging test problems.

SYSTEMS WITH A FUTURE

- Open Solutions
- Open Options
- Open Opportunities

Unlimited Flexibility in System Solutions

The Tektronix Open Measurement Environment helps you put together the ideal test-and-measurement solution for your needs. It allows you to choose products from a wide range of manufacturers of test-and-measurement technology, with confidence that all the components will work together. You can use the ideal computer hardware, the perfect software package, and the specific instruments that best suit your application.

Single-supplier, closed architectures limit your choices. With the Open Measurement Environment, they're practically unlimited.

OPEN YOUR OPTIONS

The Open Measurement Environment is an approach to doing business, not a product or a specific group of products.

It means that Tektronix goes the extra step to make sure that we are easy to do business with. We have also established strategic partnerships with industry leaders to make sure that you can tap into their products and expertise. As well, Tektronix is deeply involved with industry standards efforts to help make the world of test and measurement a truly open environment. It includes a universe of industry-standard components from various manufacturers, so the range of options available to you is in the fact much, much greater.

MORE INSTRUMENTS TO CHOOSE FROM

The Open Measurement Environment includes over 100 VXI components including modular instruments, mainframes and controllers. You'll find a broad selection of GPIB instruments as well, giving you what you need to create a high-performance solution for most every application. You can also include instruments from other manufacturers in your solutions. We're working throughout the industry to maintain open standards, ensuring cross-compatibility and ease of integration.

MULTIPLE CHOICES IN HARDWARE AND SOFTWARE

Open Measurement Environment makes it easy to combine Tektronix Instruments with the optimum hardware platform for cost-effective performance. You can use PCs, Macintoshes, UNIX workstations or embedded VXI controllers. And you can take many approaches to software design: coding in C, Atlas or BASIC, or using interactive, graphical development environments like LabVIEW,® LabWindows® or TekTMS.

Component compatibility and connectivity is simplified by the wide variety of hardware and software drivers available for various computer platforms, software packages, and instruments from Tektronix and other manufacturers.

MORE WAYS TO INTEGRATE SYSTEMS

Whether you have full system integration capabilities within your company or contract to other suppliers, the Open Measurement Environment gives you a convenient, cost-effective means to integrate systems.

COMBINE INDIVIDUAL COMPONENTS

We've created partnerships with many of the leading technology companies in test and measurement, such as Sun, Microsystems, DEC, National Instruments and Radisys. We're working cooperatively, creating common standards that ensure our components work together.

CONFIGURED SOLUTIONS

These are available for specific industries such as avionics, automotive, semiconductor and telecommunications. They consist of a controller, software, VXI chassis and a set of industry-standard instruments; you customize the software and add other instruments to complete the integration.

COMPLETE SYSTEMS FROM THE TEKTRONIX INTEGRATION CENTER

We'll assemble a complete system to your specification, and customize the application software if you desire.

TURNKEY SOLUTIONS FROM VARS AND SYSTEM INTEGRATORS

Through the Synergy program, our network of authorized VARS and System Integrators have industry-specific expertise and can provide you with a fully customized, turnkey solution.

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

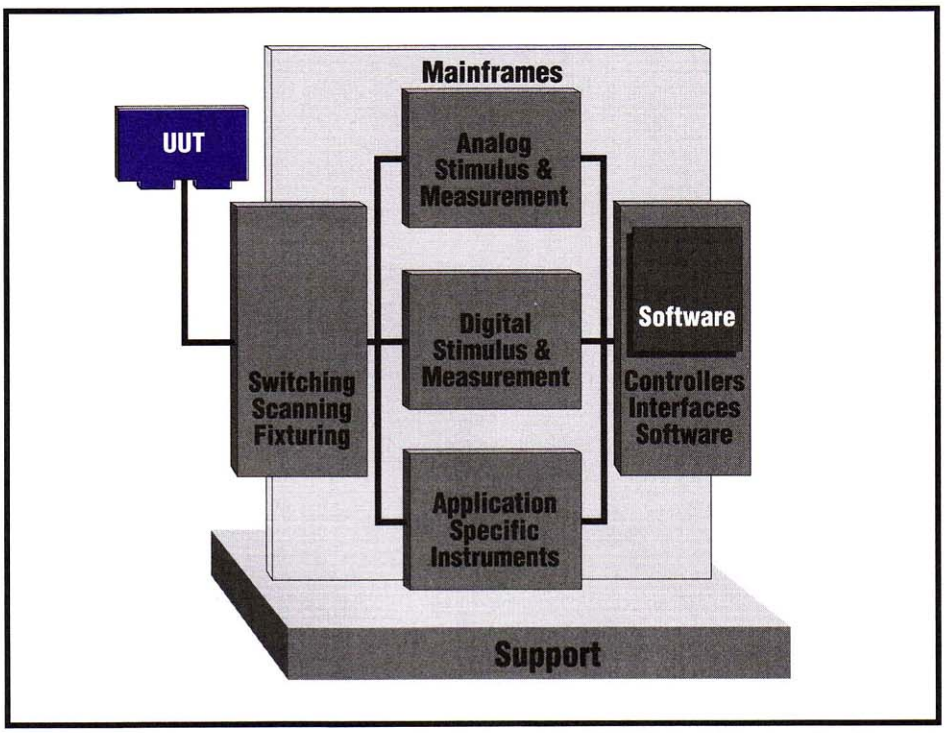
The Open Measurement Environment

INCORPORATE EXISTING RESOURCES
A flexible approach to system design makes the systems themselves more flexible. You can use many different combinations of hardware and software and leverage resources you already have in place. You can adapt existing computer systems as test-and-measurement platforms, use multi-tasking workstations to control multiple tests simultaneously or use them to run other applications.

WORLDWIDE SUPPORT NETWORK
Tektronix offers you the resources of a global service-and-support network. From on-site preparation to system design, fabrication, project management, installation, on-site service and training. Tektronix and its third-party partners can provide all the support you need for a successful solution. We can help you assess your requirements, plan testing strategy, write your software, and integrate your system. And everything in between. Tektronix service include calibration and servicing of third-party products, with response time ranging from three-day depot turnaround to four hour on-site service.

THE FUTURE IS OPEN
In addition to providing better solutions at a low cost-per-test, open standards also pave the way for data-sharing among all stages of the product development cycle. With research and development, electronic design automation and manufacturing test sharing the same pool of data, required changes can be implemented more quickly and products brought to market faster.

The Open Measurement Environment gives you solutions to today's problems with the flexibility to adapt to tomorrow's challenges.



Within the Tektronix Open Measurement Environment, you'll find the full range of instrumentation, mainframes, controllers and software, all backed by a solid foundation of support services. In addition to the Tektronix products on the following pages, it also includes a wide variety of third-party products so you can create the ideal solution for your application.

OME Standard Platforms

OME Standard Platforms are the starting point for your system solution.

A HEAD START FOR YOUR SYSTEM CONFIGURATION

- Rack Enclosure
- Workstation or PC
- LabVIEW Software
- VXI Chassis & MXI Interface, where applicable

The OME 1000 and OME 2000 are the standard base platforms for Tektronix' Configured Solutions as well as any custom configuration you wish to specify. They are intended to provide a solid foundation for most types of system integration projects, and to simplify the process – and thus reduce the cost – of designing a comprehensive system solution.

These OME 1000 and 2000 products differ in their controller environment: the OME 1000 is PC-based (using DOS), while the OME 2000 is a Sun SPARC workstation-based solution that uses UNIX.

Ready to Integrate

Each of the two platforms consists of the external controller and a standard 19 inch rack, plus appropriate cabling and interface hardware and software to drive VXI, GPIB, or both. VXI-optioned configurations are equipped with a 13-slot VXI mainframe and an MXI Slot 0 Interface/Resource Manager module.

The proven LabVIEW application development package is supplied as a standard component of every OME standard platform.

The OME rack enclosures are supplied with cooling fans, electrical power bussing, power controller, and all necessary machined parts (rack rails, etc.).

OPEN ARCHITECTURE MEANS COST-EFFECTIVENESS, COMPATIBILITY

Both OME base models offer a full slate of features and benefits:

- Based on, and compatible with, industry-standard components and interfaces
- Hardware and software compatibility with the broadest range of measurement instruments
- Easy to integrate, upgrade, and maintain; less system development effort required
- Scalable and readily expandable with both VXI and GPIB instrumentation
- Large library of instrument drivers for instrumentation from most leading vendors
- Tektronix' responsive worldwide service and support for your entire system, including controller, software, and all instruments

POWERFUL GRAPHICAL SOFTWARE ENVIRONMENT

The OME application development environment for both the PC and Sun-based configurations is National Instruments' LabVIEW package, effectively the industry standard in its field. LabVIEW is a graphical programming system that includes all the major software interfaces (for example, DDE and DLL) and a large, proven library of instrument drivers. For more information about LabVIEW, see page 274 in this catalog.

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

OME Configured Solutions

OME1100-00/OME2100-00

TEST SYSTEMS FOR ELECTRICAL SENSORS

Electrical sensors are used to monitor speeds, temperatures, liquid levels, and other quantitative data throughout complex electromechanical systems. They are critical to both the functionality and the safety of diverse environments and therefore must be subjected to exhaustive quality control testing before they are shipped.

The OME1100/2100 are fully-integrated VXI-based sensor test systems that provide a solution to this demanding test problem. They provide stimulus and acquisition for parametric testing of the full range of sensor functions, including: transmission speed, coolant temperature, air bag deployment, throttle position, liquid level, and many more.

Among the tests OME1100/2100 systems are equipped run:

- Continuity
- DC Offset
- Sensitivity
- Nonlinearity/distortion
- Frequency Response
- Damping Factor
- Phase Measurement

The open, flexible OME architecture saves retooling cost as test needs change. This is particularly valuable in the automotive industry, for example, where annual model changes mean new test requirements each year.

Thanks to their efficient VXI implementation, the OME systems yield high throughput and low cost of test. They are extremely compact – an important consideration given the cost of factory floor space – and their test times are shorter than those of traditional instrument systems.

The standard configuration of the OME1100/2100-00 consists of the base OME platform plus the following VXI components:

- Waveform Analyzer
- Function Generator
- DMM
- Serial Bus Interface
- Digital I/O Module
- Switching Module
- DUT Interface

This configuration can of course be supplemented with additional instruments as required by your application. Thanks to the open OME architecture, you can select your ancillary instruments from virtually any established vendor.

OME1200-00/OME2200-00

TEST SYSTEMS FOR AVIONICS SUBSYSTEMS

Time to market is critical in the rapidly changing avionics industry. Cutting system development time reduces both the time and the expense of bringing the latest avionics technology into the marketplace. The best way to shorten system development time is with a fully integrated, flexible, open-architecture solution. Recognizing this, Tektronix has applied its 40-plus years of avionics test experience to create two powerful solutions for avionics testing.

The OME1200/2200-00 are application-ready VXI-based systems configured with the digital and analog capability to to fulfill most avionics testing needs. Their VXI implementation ensures higher throughput than discrete instrument-based systems and the included LabVIEW application development software reduces programming time, and therefore cost. Moreover, their open architecture makes them easy to expand and enhance as your test needs change.

The OME avionics test systems are supplied with the following complement of modules:

- A/D module
- Serial Bus Interface
- Discrete Output Module
- Switching Module
- Matrix Switching Module
- DUT Interface (ARINC 608A or Virginia Panel Corp.)

The supplied Serial Bus Interface can be configured for MIL-STD-1553, and ARINC 429/629 bus testing.

The OME2200-00 model, like the other OME workstation-based products, is fully network-capable. This links the test station to factory networks for test program archiving and downloading, and for quality control database transactions.

CONFIGURED WITH THE TOOLS YOU NEED

- Stimulus Instruments
- Measurement Instruments
- Workstation & Application Development Software
- Switching Matrix
- UUT Interface (OME1200/2200)

OME Configured Solutions can get your test operation up and running rapidly, or can be used as the basis for further customization.

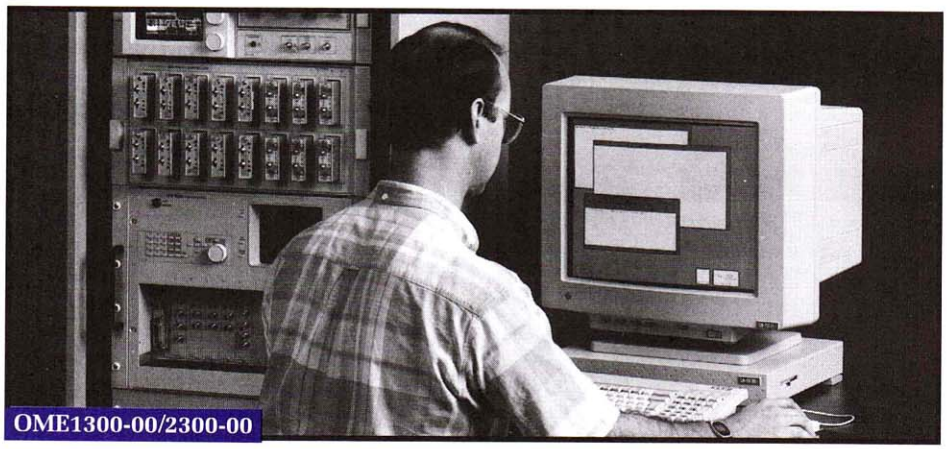
To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

OME1300 OME2300 OME1400 OME2400 OME Configured Solutions

Powerful special-purpose GPIB instruments make these systems perfectly suited to their application.

PERFORMANCE FOCUSED ON THE TESTING TASK

- "Application-Specific" GPIB Instruments make your semiconductor and telecommunications tests faster, more accurate.



OME1300-00/2300-00

OME1300-00/OME2300-00

SEMICONDUCTOR CHARACTERIZATION SYSTEMS

Semiconductor characterization requires extraordinary precision on both the stimulus and response sides. After all, it determines the data sheet specs of semiconductor products and influences the guardbands used in their production testing. A minute inaccuracy in defining, say, the setup and hold time of a device's inputs can degrade the value of thousands of parts. The test system's multiple stimulus and acquisition channels must be closely synchronized and its resolution and accuracy must be beyond reproach.

The OME1300/2300-00 are fully-configured characterization systems equipped with the instruments needed to perform the most critical semiconductor timing measurements, namely: Crosstalk, Metastability, Fmax, Setup & Hold, Minimum Pulse Width, Ground Bounce, Propagation Delay, and more.

A Tektronix HFS9000 Series Data Time Generator and a Tektronix 11801A Oscilloscope form the heart of the system, with 12 stimulus and 8 acquisition channels respectively. Channel count is expandable: stimulus to 36 channels and acquisition to 40. The OME1300/2300/xx also includes the necessary DUT power supplies and a DMM for verifying DC levels.

As with the other OME systems, the included LabVIEW software eases the application development task, and the open OME architecture as well as the the availability of either workstation or PC platforms ensures compatibility with your existing factory databases and networks.

OME1400-00/OME2400-00

OPTICAL COMMUNICATIONS STANDARDS TEST SYSTEMS

The need to ensure conformance among the hundreds of products affected by the SDH/SONET and FDDI communications network standards has precipitated a set of tests best carried out by automated test systems. A full test solution for these standards must offer waveform and timing analysis, bit error rate testing, and optical testing, as well as the ability to be enhanced with a wide variety of other functions.

The OME1400/2400/xx are application-ready test systems with the functionality and precision to perform the full battery of SDH/SONET and FDDI standards tests, including (but not limited to):

- Waveform parametrics
- Mask/template compliance
- Eye pattern analysis
- Optical waveform analysis & power measurement
- Bit error rate performance
- Electrical measurements (voltage, current, etc.)

As with all other OME systems, the OME1400/2400/xx are designed for openness and compatibility with instruments from all vendors. The choice of computer platforms – DOS-based PC or UNIX workstation – is unique among telecommunications test systems. Moreover, they are shipped with the renowned LabVIEW application development software package, a proven aid to programmer throughput and efficiency.

For more information about Tektronix OME products, contact your local Tektronix sales representative, or call 1-800-426-2200 (or 503-627-7111 for international calls) and ask for Operator 32.

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

Tektronix System Integration Services

Experienced System Specialists

For many test problems, "catalog shopping" is not the right approach. Configuring the solution, selecting components, and integrating the test system are beyond the scope of many system users, and certainly outside the business charter of most. Often it is most economical to entrust these tasks to an experienced specialist – a system integrator.

Tektronix offers a wealth of alternatives for system integration services. Working with the Tektronix Integration Center, with a Synergy program partner, or through the OMS or Tek/DEC programs, you can create a system exactly matched to your test requirement. Whatever your hardware or software platform, your operating system, networking, or program development environment, Tektronix is ready to solve your test problem with a powerful *open* solution. And, as with all its products, Tektronix guarantees uniform quality, compatibility, and long-term support on a global scale.

THE TEKTRONIX INTEGRATION CENTER (TIC)

The TIC is chartered to offer services that apply that Tektronix' 25 years of system-building experience to today's challenging test problems. Among the TIC's range of services:

- System Design Consultation
- Equipment Integration
- Mechanicals, Fixturing, Cooling & Safety
- Turnkey Systems Design & Fabrication, including:
  - Requirements Analysis
  - Test Strategy Development
  - Selection of instruments, controllers, and software
  - Software Development
  - Fixturing Design & Fabrication
  - Cooling & Safety Planning
  - Documentation
  - After-Sale Support & Service

If your application has unique instrumentation, fixturing or software requirements, or if your test operation runs on a workstation platform rather than the conventional PC, Tektronix will work with its system partners to configure and integrate your solution. The list of partners and associates includes some of the leading names in both system integration and workstations, and is constantly expanding to include more specialists in such areas as automotive, semiconductor characterization, telecom, and avionics testing.

THE SYNERGY PROGRAM

The Synergy program is a strategic partnership between Tektronix and select systems integrators, value-added resellers, and independent hardware and software vendors. This relationship combines the "insider" expertise of proven industry specialists – for example, TRW, the Digital Enterprise Integration Center, and SAIC, each a leader in test system design – with the worldwide service and support resources of Tektronix. Each Synergy partner is verified and endorsed by Tektronix, and every Synergy-built product carries the full Tektronix System Warranty.

THE OPEN MEASUREMENT SOLUTIONS PARTNERSHIP (OMS)

The OMS partnership teams two test and measurement leaders – Tektronix and National Instruments – with Sun Microsystems, the leader in high-performance workstations. Each of the three partners contributes a complementary product to the OMS solution: Tektronix its broad range of VXI and GPIB test instruments, National the proven LabVIEW® application development software package, and Sun the powerful UNIX® computing and networking capability of its renowned SPARC workstations.

Both custom and standard system packages are produced under the OMS banner. Whatever your need, OMS can provide a solution – from guaranteed compatible single modules to fully integrated system networks.

THE TEKTRONIX/DIGITAL EQUIPMENT CORPORATION SYSTEMS PROGRAM (TEK/DIGITAL)

Digital Equipment Corporation workstation and operating system platforms are at the heart of many manufacturing, process control, and research environments. Working together, Tektronix and Digital can now provide solutions combining Tektronix VXI and GPIB instruments with Digital hardware and software, yielding for the first time a commercially-available integrated test system solution for Digital-based networks. Importantly, the Tek/Digital system products support traditional high level languages like ADA, UNIX C, Basic, Fortran, and Pascal via Digital's RTI software package.

SYSTEM SOLUTIONS SERVICES

- High-Quality Fully Integrated Open Systems
- Custom Hardware and Software
- System Design and Configuration Consulting

System integration services from the world's leading specialists.

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

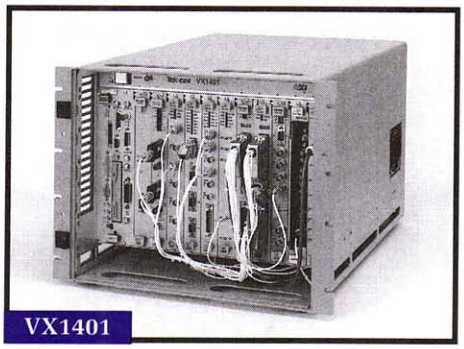
Card/Modular Instruments

Mainframes, Slot 0 Modules, Controllers

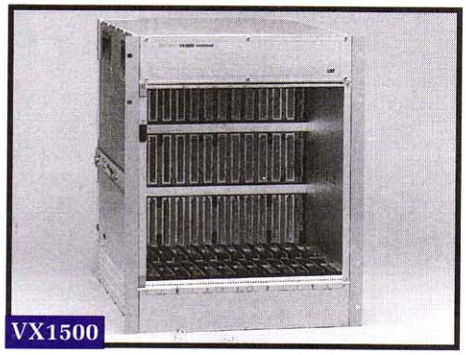
Tektronix offers a broad and diverse range of modular instruments for system applications. Form factors include VXI, CDSbus, and TM5000 configurations. Virtually any test function can be fulfilled with a modular automated instrument from Tektronix.

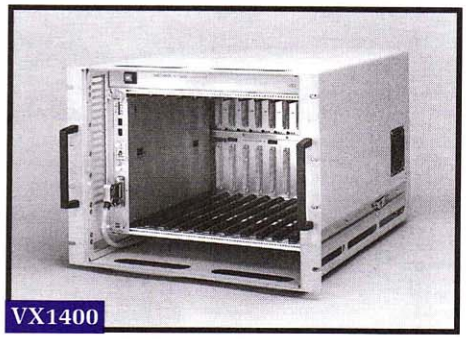
VXIBUS AND CDSBUS PRODUCTS

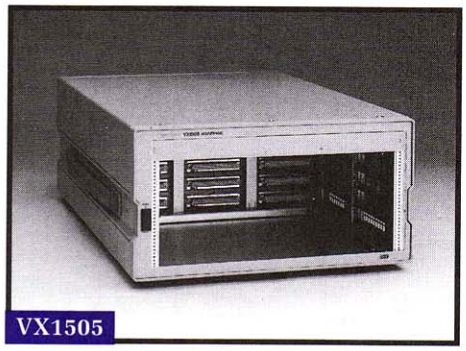
- Mainframes
- Modules
- Controllers
- Measurement Instruments
- Stimulus Instruments
- Switches
- Scanners
- Switch Matrix and Relay Drivers
- CDS Switches



Fully Loaded VX1401







Mainframes, Slot 0 Modules, and Controllers

Tektronix has the solution for housing and controlling your test system.

We offer the widest choice of VXI mainframes on the market. Both "C" and "D" sizes are available, with 5- to 13-slot capacity and several power output configurations to meet your requirements.

We have a complete line of Slot 0 devices in "C" and "D" sizes for controlling your system via GPIB. In addition, Tektronix offers a variety of embedded controllers, both 386- and 486-based. These embedded controllers provide the sheer compute power needed for high-throughput applications.

Tektronix Mainframes

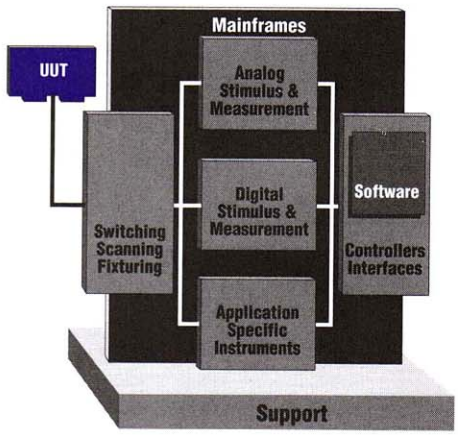
VX1400	"C" size 13-slot VXI mainframe
VX1401	"C" size 13-slot VXI mainframe
VX1405A	"C" size 5-slot VXI mainframe
VX1500	"D" size 13-slot VXI mainframe
VX1505	"D" size 6-slot VXI mainframe
53B	CDSbus 10-slot mainframe
63B	CDSbus 5-slot mainframe
64B	CDSbus 6-slot mainframe

SLOT 0 DEVICES

VX4520	"C" size Slot 0
VX4521	Enhanced "C" size Slot 0
VX5521	"D" size Slot 0

EMBEDDED CONTROLLERS

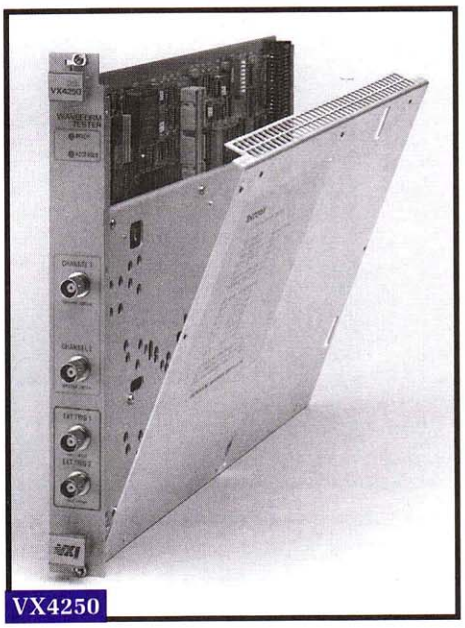
EPC-2	"C" size Embedded 80386 Controller
EPC-7	"C" size Embedded 80486 Controller
VX5535	"D" size Embedded 80386 Controller

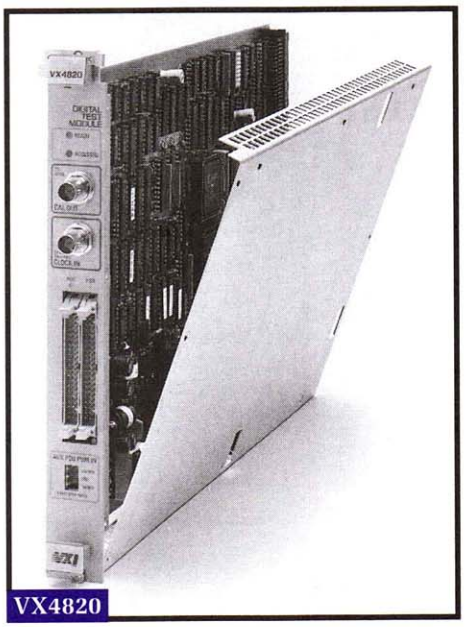


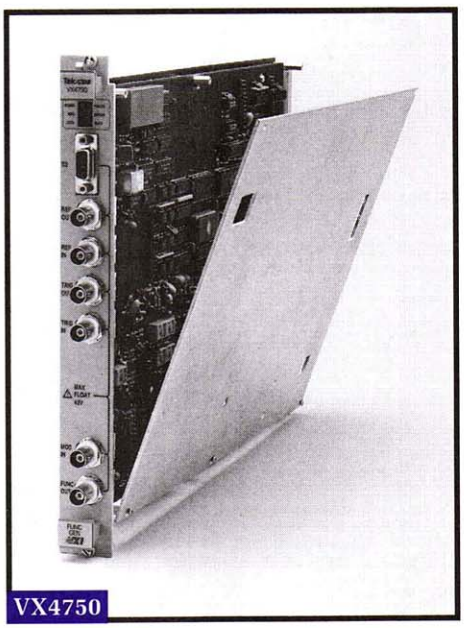
To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

Card/Modular Instruments

Measurement/Stimulus Instruments


VX4250


VX4820

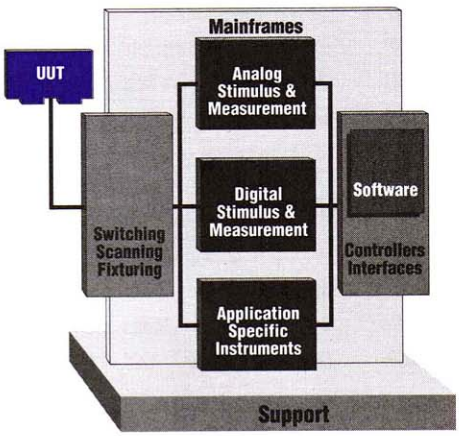

VX4750

Measurement Instruments

VX4223	Universal Counter
VX4234	4-1/2 digit DMM
VX4236	6-1/2 digit DMM
VX4240	Waveform Analyzer
VX4250	Waveform Analyzer
VX4281	Power Meter
VX4286	Digital Input/Analog Comparator
VX5260A	"D" size Digitizer
73A-541	Universal Counter
53A-226	Thermocouple Measurement
53A-519B	16-channel Digitizer

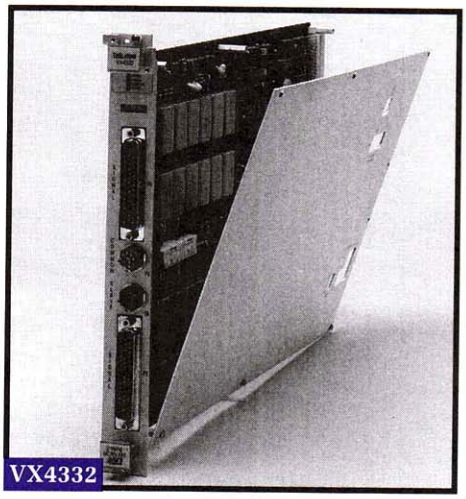
Stimulus Instruments

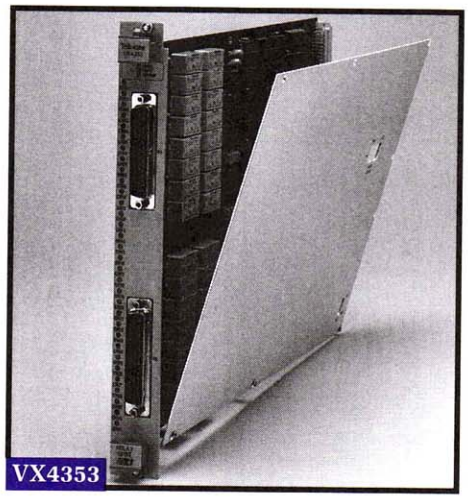
VX4342	Programmable Resistance
VX4730	12-channel DAC
VX4750	Function Generator
VX4790	Arbitrary Waveform Generator
VX5790	"D" size Arbitrary Waveform Generator
73A-270	Serial Pattern Generator

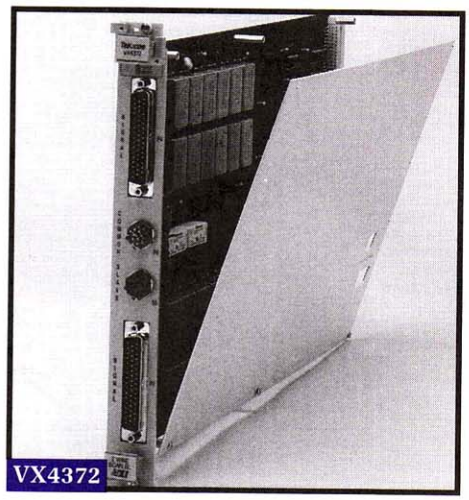


Card/Modular Instruments

Switching/Scanning


VX4332


VX4353


VX4372

Switches

VX4353	SPST Relay switch
VX4355	DPST or SPDT Relay switch
VX4356	DPDT Relay switch
VX4357	SPDT Relay switch
VX4363	SPST low cost switch
VX4366	DPDT low cost switch
VX4367	SPDT low cost switch

Scanners

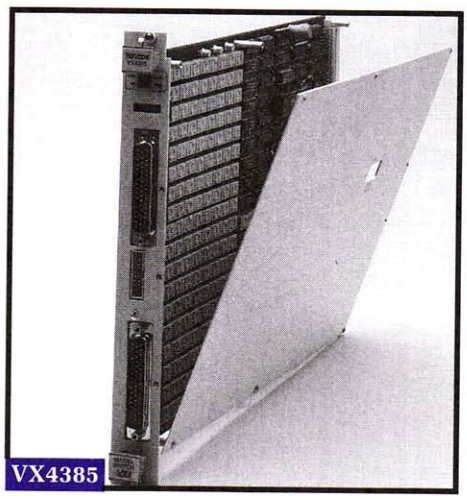
VX4332	2-wire Scanner Master
VX4372	2-wire Scanner Slave
VX4334	4-wire Scanner Slave
VX4374	4-wire Scanner Slave
VX4440	Scanner Master

Switch Matrix and Relay Drivers

VX4385	128-Relay Switch Matrix
VX4386	128 Latching Relay Switch Matrix
73A-308	Relay Driver

CDS Switches

53A-324	Microwave Scanner
53A-323	RF Switch
53A-310	FET Scanner Master
53A-311	FET Scanner Slave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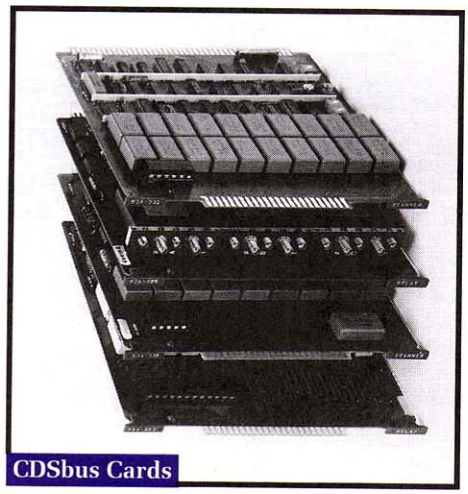
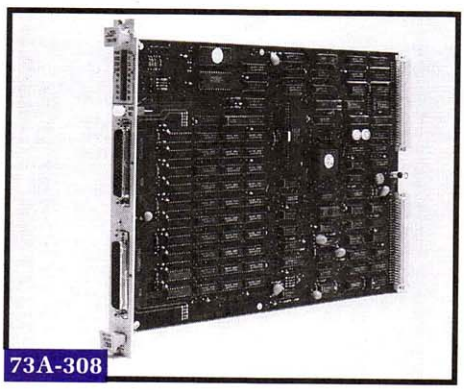
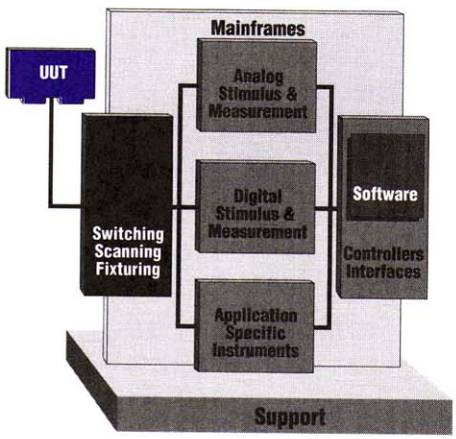

CDSbus Cards

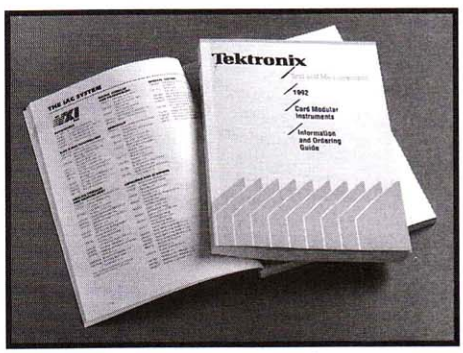

73A-308



Card/Modular Instruments

Getting Started With Your System

Tektronix will work with you from initial concept through finished systems. Whether you are looking for a single instrument, a mainframe full of instruments or a complete system, Tektronix is the right place for your solution.



Ordering and Information Guide

NEED MORE INFORMATION?

Our Information and Ordering Guide covers Tektronix' complete line of card-modular instruments and related products. Within it you will find detailed descriptions and specifications of every Tektronix card modular product. To request a copy of this comprehensive publication, contact your local Tektronix sales office or call 1-800-TEK-4VXI.

The Tektronix Systems Team is ready to serve you.

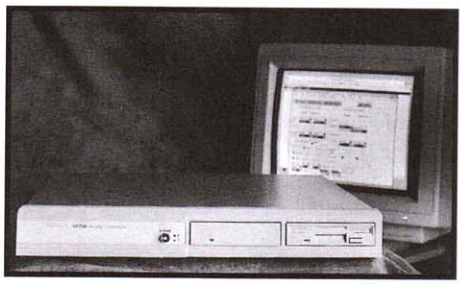
To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

Instrument Controllers and Interfaces

Embedded VXI controllers to make your system more compact and efficient; scope-mounted controllers to transform your oscilloscope into a true measurement system.

EPC/MXI/RIC/SUN/PC

- System Controllers
  - External
  - Embedded
- Controller Interfaces
- System Software



Instrument Controllers and Interfaces

Tektronix offers a suite of controllers, interface hardware and software for automated instrumentation control. Whether the test requirement calls for GPIB, VXIbus, or a combination thereof, Tektronix can provide a powerful, cost-effective controller or interface perfectly matched to your needs.

As a strong advocate of the open systems approach, Tektronix is a leader in furthering the development of standards for instrumentation systems. Tektronix evaluates all of its system controllers and interfaces for adherence to standardized interface rules. This evaluation ensures straightforward system integration and gives the system designer the latitude to use the most appropriate instrumentation and programming tools, regardless of the vendor.

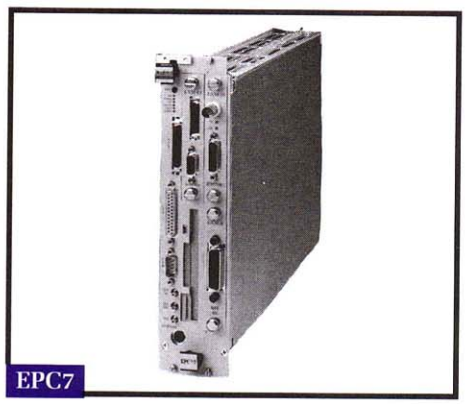
SYSTEM CONTROLLERS

Depending upon its instrument configuration, cost constraints, and throughput requirements, a test system might best be controlled from either an external PC-type controller or an embedded VXI controller.

Of the two alternatives, external controllers are typically the more flexible and configurable. Within this format, it is possible to achieve either minimum cost, or massive but cost-effective compute power. Embedded controllers, on the other hand, provide an optimized high-performance interface to VXI instruments and require the least physical space.

External Controllers Tektronix offers a range of external controllers with different price and performance levels and physical formats. For example, the Tektronix RIC386 instrument controller is a PC-compatible controller featuring a built-in GPIB port. Its compact rack-mountable enclosure lends itself to system applications.

Embedded Controllers Tektronix offers the widest choice of embedded controllers of any vendor. Our newest embedded controller, the EPC7, is an 80486-50 based controller with up to 64 Mbytes of DRAM and a 240 MB hard drive. Many options are provided to allow the controller to be tailored to specific system needs. A 386-based controller, the EPC2, is available at lower cost for less performance-critical situations.



EPC7

CONTROLLER INTERFACE PRODUCTS

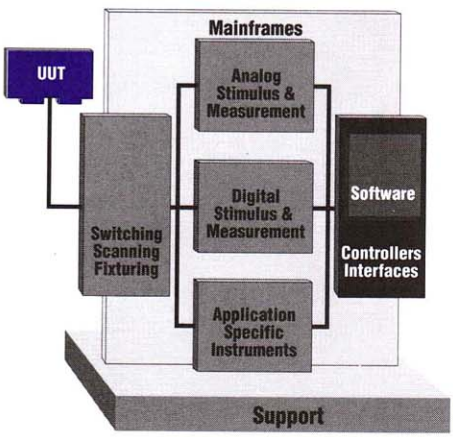
Tektronix controllers interface to instruments in one of several ways. Among the most common interfaces are GPIB and MXI. Tektronix offers interface cards in each of these formats. The card and its software must be matched with the operating system, and computer bus format which is desired. MXI is often chosen when the system controller is in the workstation class. This combination offers the highest possible performance available in an instrument system.

SYSTEM SOFTWARE

System software includes several kinds of software packages. Use our experience help you select the combination that will work best for you. Our controllers support various operating systems and related system software. Because we emphasize an open systems approach the capabilities you need are probably already available in a standard package.

Planning a Test System Configuration

Tektronix wants to help you make the right choices in planning your test system. If you are designing a configuration now, a Tektronix systems specialist is available to discuss your plans. Contact Tektronix at the phone or FAX number below to begin defining the solution to your testing problem.



To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

Instrument Controllers and Interfaces

EPC | SUN
MXI | PC
RIC

Before selecting a configuration you should be prepared to answer these questions.

- How many systems of this type will be needed?
- How many years will these systems be in use?
- Is the ability to upgrade and expand important?
  - When?
  - By how much?
- What are the mandatory functions and requirements of the system?
  - Now?
  - In the future?
- What information must be provided by the system to whom?
  - How often?
  - How fast?
- What information must be provided to the system by whom?
  - How often?
  - How fast?
- What skill levels are available to develop, operate, troubleshoot, and maintain these systems.

The Right Choice

Certainly no single architecture will be right for all users. Tektronix provides a wide choice of controllers and interface products. Let us work with you to guide you through the choices and assist you in arriving at the right choices for your situation.

ORDERING INFORMATION

EPC7D
U.S. Development System "C" size embedded VXI Controller **$13,810**
Includes: 80486 CPU, 16MB DRAM, 240MB HD, GPIB, and Ethernet.

EPC7DI
International Development System *1
Includes: EPC7D with 50 Hz 220 V power.

EPC7R
U.S. Runtime System "C" size embedded VXI Controller **$11,415**
Includes: 80486 CPU, 8MB DRAM, 100MB HD, and GPIB.

EPC7RI
International Development System *1
Includes: EPC7R with 50 Hz 220 V power.

EPC7B
80486 Base Unit "C" size embedded VXI Controller **$6,995**
Includes: An extensive list of options to configure the exact system you need. Some of these options include: DRAM to 64 MB, HD to 450 MB, EXM I/O expansion modules, Application software packages.

EPC2
80386 Base Unit "C" size embedded VXI Controller **$4,995**
Includes: An extensive list of options to configure the exact system you need.

VX5535
80386 Base Unit "D" size embedded VCI Controller **$24,000**
Includes: 80386 + 80387, 8 MB DRAM, 40 MB HD, GPIB, and P3 functions.

RIC386
80386 Desktop/Scope-Mount Controller **$2,490**
Includes: 80386SX, 4 MB DRAM, 50 MB HD, built-in GPIB, and slimline.

MXIPCDOS
MXIbus Interface Kit for PC-AT and DOS *1
Includes: AT-MXI Board, Standard VXI-MXI Board, 2 m M1 MXI Cable and NI-VXI DOS.

MXIPCWIN
MXIbus Interface Kit for PC-AT and MS Windows *1
Includes: AT-MXI Board, Standard VXI-MXI Board, 2 m M1 MXI Cable and NI-VXI Windows.

MXISUN
MXIbus Interface Kit for SUN *1
Includes: Sbus Board, Standard VXI-MXI Board, 2 m M1 MXI Cable and NI-VXI SunOS.

MXIVXI
MXIbus Interface Kit for VXI Controller and DOS *1
Includes: Enhanced VXI-MXI Board, 2 m M1 MXI Cable and NI-VXI DOS.

SPARCIPX
SUN Development System for LabView *1
Includes: SPARC Integer and Floating Point CPU @ 40 MHz, 32 MB DRAM, Desktop Package, SCSI, Ethernet, two Serial, Audio Input/Output Ports, Integrated 8-bit GX Accel., two Internal S-bus Expansion Slots, 19 in. Color Monitor, 32 MB RAM, 424 MB Internal SCSI HD, 1.44 MB 3.5 in. Internal Floppy Drive, SOLARIS installed, 644 MB Desktop SunCD Pack.

SPARCIPC
SUN Run-Time System for LabView *1
Includes: CMOS SPARC Integer CPU @ 25 MHz, Desktop Package, SCSI, Ethernet, two Serial, Audio Input/Output Ports, Integrated 8-bit BX Accel., two Internal S-bus Expansion Slots, 16 in. Color Monitor, 16 MB RAM, 207 MB Internal SCSI HD, 1.44 MB 3.5 in. Internal Floppy Drive, SOLARIS installed, 644 MB Desktop SunCD Pack.

PC486LV
80486 Desktop Controller with LabView *1
Includes: 486DX2 50/25, 16MB RAM, 240 MB IDE HD, 1.44 MB 3.5 in. Internal Floppy Drive, DOS/Windows, LabView (installed), Keyboard & Mouse, SVGA Monitor.

PC486LW
80486 Desktop Controller with LabWindows *1
Includes: 486DX 33, 8 MB RAM, 120 MB IDE HD, 1.44 MB 3.5 in. Internal Floppy Drive, DOS/Windows, LabWindows (installed).

This information is intended to give you a quick guide. However, due to the rapid changes in the features and prices of controllers we strongly recommend contacting your local Tektronix representative for a current list of options and prices.

**1 Contact your local Tektronix representative for price information.*

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

System Software Solutions

Software makes the difference in the systems world. Tektronix offers three of the industry's most versatile packages.

PERFORMANCE FOCUSED ON THE TESTING TASK

- "Application-Specific" GPIB

LABVIEW APPLICATIONS

- Device Characterization
- Medical Research
- Automotive Engineering
- Basic Electronic Testing
- Process Monitoring and Control

TEKTMS APPLICATIONS

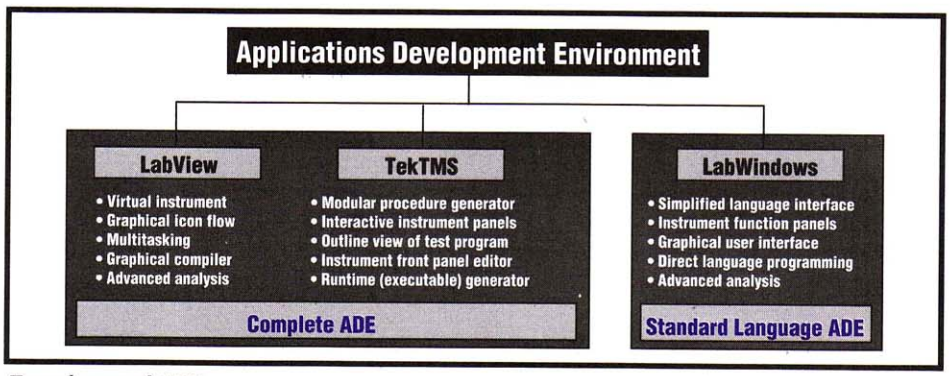
- Avionics Manufacturing Test
- Medical Manufacturing Test
- Low-Volume Hybrid Test
- Telecom Manufacturing Test
- Incoming Inspection

LAB WINDOWS APPLICATIONS:

- Avionics LRU Manufacturing Test
- Telecom Manufacturing Test
- Automotive Manufacturing Test
- Product Development Testing
- High-Volume Board Test

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

GPIB IEEE-488 — The ADE and TekTMS comply with IEEE Standard 488.1-1987, and with Tektronix Standard Codes and Formats.



Two classes of ADE.

System Software

As with its system hardware offerings, Tektronix strives to provide the most flexible, advanced software solutions for test program development. Recognizing that test programming costs can equal or surpass hardware costs, Tektronix has chosen an open systems approach to protect your software investment with an efficient solution today and a path toward the future. The open system concept delivers compatibility across diverse vendors' hardware and software environments.

APPLICATION DEVELOPMENT ENVIRONMENT TOOLS SAVE TIME, MONEY

Tektronix offers a range of software Application Development Environment (ADE) products that addresses the most sensitive programming issues: throughput, ease of use, flexibility, standardization, and more.

These productivity tools allow programmers to focus on results. They contain ready-to-use functions (i.e., GPIB control, data plotting, analysis, etc.) for most common testing procedures that can be quickly and easily incorporated into an application program. The programmer is freed from having to know the detailed technical requirements of the test system; instead, he or she can concentrate on the needs of the unit under test (UUT).

Tektronix offers two classes of ADE: Complete and Standard Language.

COMPLETE ADE

Complete ADE provides an iconic and/or menu-assisted environment for program development. It is equally suited to generating simple routines or comprehensive test programs. In either case, there is no interaction with standard language tools. Complete ADE has the ability to incorporate user-supplied routines so that unique proprietary tests can be used again and again.

Complete ADE offers several important benefits:

- Novice programmers can generate applications programs
- Common user interface to system functions and instruments
- Consistent programming style
- Modular software routines

Tektronix offers two products in the Complete ADE category: TekTMS and LabView.

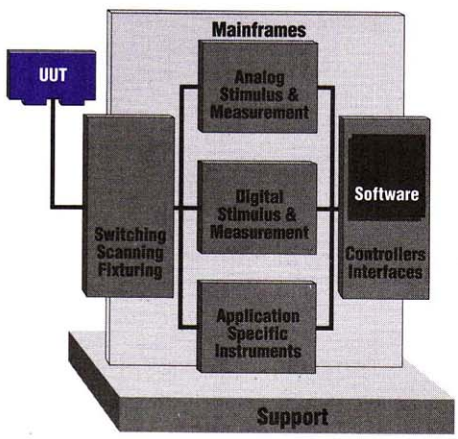
STANDARD LANGUAGE ADE

Standard Language ADE is aimed at the more experienced programmer who prefers the familiar look and feel of conventional programming languages like "C" and QuickBASIC. It provides access to extensive libraries of functions for instrument control, data analysis, and data presentation. Like complete ADE, Standard Language ADE frees the programmer from system-related technical minutiae and puts the emphasis on solving the UUT test problem at hand.

Among the benefits of Standard Language ADE:

- Familiar, proven programming environment consistent with thousands of installed test programs
- Abundant source of pre-programmed function calls
- Logical programming style, use of pull down menus
- Extensive development environment

Tektronix offers the popular LabWindows package as its Standard Language ADE solution.



System Software Solutions

LabWindows
TEKTMS
LabView

Tektronix Test Management System (TMS)

- Easy-to-Use Outline View of Test Program
- Program Instruments with Interactive Instrument Front Panels
- Provides Powerful Time and Amplitude Waveform Processing for Complex UUT Signals
- Displays UUT Component Layouts and Schematics
- Controls Instruments on the VXIbus, GPIB Bus, and RS-232 COM Ports
- Develop Instrument Front Panels with Instrument
- Familiar Microsoft Windows Interface Makes Getting Started Easy

TekTMS provides a highly productive software package for test development and execution in manufacturing, repair/rework, and prototype development testing applications.

INTERACTIVE PROCEDURE GENERATOR

The Interactive Procedure Generator (IPG) provides easy-to-use dialog menus to simplify test development and eliminate syntax errors. Instrument control steps are as easy to create as pushing a button on an instrument software front panel. The IPG editor creates an "Outline View" of the test program with steps chosen from the Instruments, Operator, or Actions menus.

RUNTIME CODE GENERATOR

The runtime code generator in conjunction with the Microsoft C compiler provides dramatically improved speed and performance.

VXI AND GPIB INSTRUMENT FRONT PANELS

Instrument Front Panels create instrument procedure steps without hardware and manipulate on-line instruments for interactive development sessions. Use the mouse to set up instrument controls for a test step. Instrument front panels may be placed on screen as icons and enlarged to full size when needed. Choose Instrument Front Panels from two libraries. The libraries provide a software file and context sensitive help for each instrument.

TEKTMS FRONT PANEL EDITOR

Front Panel Editor (FPE) is an optional TekTMS Microsoft Windows application for creating and editing instrument front panels (instrument drivers) for use with the TekTMS Interactive Procedure Generator.

LabWindows®

- Interactive Program Development
- Automatic Code Generation
- Libraries for Programming GPIB, VXI, and RS-232 Instruments
- User Interface Library for Creating Graphical User Interfaces
- Uses Standard Programming Languages – Microsoft QuickBASIC and C

LabWindows is a software development system for building test and measurement applications. LabWindows gives QuickBASIC and C programmers a complete set of development tools to create PC-based instrumentation systems with GPIB, VXI, and RS-232 programmable instruments. The development system includes an interactive development environment and function libraries for data acquisition, instrument control, data analysis, and data presentation.

The LabWindows Standard Package gives users an interactive environment for developing QuickBASIC and C programs. In the environment, users can call any of the functions in the LabWindows Libraries. The libraries include the GPIB Library, RS-232 Library, Data Acquisition Library, Formatting and I/O Library, Analysis Library, Graphics Library, User Interface Library, and the Instrument Library. The development environment has pull-down menus and optional mouse support for simple and direct access to all editing and debugging tools. Debugging tools include break points, single-stepping, and the ability to view and edit program variables and data when running a program.

OPTIONAL LABWINDOWS LIBRARIES

VXI Library: Complete set functions for controlling VXI instruments from GPIB, MXI, or embedded PC-controllers. Functions are available for communication with both message based and register based devices.

Advanced Analysis Library: High performance analysis library with over 125 functions that include: signal generation, real and complex FFTs, inverse FFTs, FHT and inverse FHT; power spectrum; integration; differentiation; convolution; correlation; pulse parameters, FIR and IIR digital filters; windowing functions; curve fitting; variance, RMS, linear equations; one- and two-dimensional polynomial evaluation.

LabView

Lab View is an icon-based graphical programming system that simplifies scientific and engineering programming. Lab View is now available on the Apple Macintosh, IBM PC running Microsoft Windows 3.x, and Sun Microsystems SPARCstations running Open Windows or MIT's X-Window System.

Because Lab View is a complete programming language–featuring programming structures, modularity, hierarchy, and extensibility–many professional programmers choose it over a text-based language because they can develop their applications faster in a graphical environment.

ORDERING INFORMATION

TekTMS Development System **$1,995**
Includes: Interactive Procedure Generator, VXI/GPIB Instrument Front Panel Library.

S3FG909
LabWindows Kit **$1,495**

S3FG910
LabWindows Std. Package **$695**

S3FG911
LabWindows Runtime Library **$195**

S3FG912
LabWindows Analysis Library **$895**

S3FG919
LabView PC Kit **$1,995**

S3FG920
LabView PC Base **$995**

S3FG921
LabView PC Base Analysis **$1,095**

S3FG922
LabView PC Base RT **$495**

S3FG923
LabView Sun Kit **$3,995**

S3FG924
LabView Sun Runtime **$995**

S3FT002
Tek TMS Kit **$1,995**

S3FT100
Tek TMS IPG **$595**

S3FT110
Tek TMS RTG **$795**

S3FT120
Tek TMS FPE **$495**

S3FT200
Tek TMS VXI Drivers **$495**

S3FT300
Tek TMS GPIB Drivers **$495**

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

Test and Measurement Software

Tekware Programs Complement Tektronix Instruments

With technology more complex and schedules becoming shorter, the need to automate test and measurement environments is greater than ever.

Tektronix can meet your need for improved test and measurement productivity in the lab, on the factory floor, or at the remote site. Tekware programs are designed to enhance the productivity of Tektronix instruments and controllers.

Tektronix has performed extensive software testing to verify that all standard Tekware measurement, analysis, and utility packages run reliably with Tektronix instruments and controllers. MS-DOS Tekware programs have been tested for compatibility with 286/386 IBM compatible PCs.

APPLICATIONS SOFTWARE

Tekware applications software provides a wide selection of ready-to-use general purpose control, measurement, and display capabilities. Simply load Tekware applications into your controller, and your system is ready to go to work for you. If your software requirements do not call for unique processing or specialized control functions, Tekware applications software could be the shortest path to a complete system solution.

DEVELOPMENT SOFTWARE

Tekware development software tools can be used to create new software or to modify existing software. Some Tekware development software products contain test program generators enabling you to create test procedures without writing a single line of code.

If your testing requirements call for development of a custom program or for customizing an existing program, a Tekware development software tool could be the key to the solution.

UTILITY SOFTWARE

Tekware utility software instrument drivers, peripheral drivers, processing modules, and display modules can be linked to other Tektronix or non-Tektronix software to produce custom programs. Using Tekware utility software whenever possible, rather than developing your own code, can substantially reduce software development time.

SOFTWARE SUPPORT

To keep your software current and up-to-date, our software support is available at no charge during the warranty period. Post-warranty software support is available on a subscription basis.

Software Selection Guide

The software product chart on the following page provides an easy way to match software to Tektronix instruments and to your measurement needs.

HOW TO USE THE TEKWARE CHART:

By Software Package

Find the software package in the list on the left side of the chart. Follow across the row for the instruments supported.

By Instrument

Find your instrument in the list at the top of the column. Follow down the column to identify Tekware packages which support this instrument.

CONTENTS

Selection Guide....278
CAT200....112
1230/PC RS232 Application....182
278X/PC Utility....209
271X/PC Utility....209
Grasp General RF Applications....209
RSM Remote Site Monitoring....209
Commercial EMI Test....212
EMI Prequalification....212
Frequency Enhancements s/w Utility....256
LabView....274
LabWindows....274
Tektronix Test Management System (TekTMS)....274
Integrated TeleServicing Support....279
WaveSaver....279
EZ-Test Test Development....280
WaveWriter Creation/Editing....282
11000 Series DSO IBM PC Utility....283
370 Device Test....398
371 Device Test....400

Test and Measurement Software

Quick Reference

Product Name MS-DOS TEKWARE™	Product NUMBER	Page Reference	TDS 400, 500, 600, 800	DSA 601A/602A	118001A/CSA 803	11402A/11403A/CSA 404	2430A/31L/32A/39/40 DSO	2221A/24/30/32 DSO–GPIB	2221A/24/30/32 DSO–RS-232	222/A, 222PS, 224 DSO	RTD 710/A Digitizer	RTD720/A Digitizers	SCD1000/5000 Digitizer	7104 1 GHz, Analog Scope	2467B/65A/B/45A/B Scope	DCS01/MUX16 Digital Camera	7D20 Programmable Digitizer	2782/2784 Program, Spectrum Analyzer	490P-2750P-2790-Series Pgm. Spectrum	2710/2711/2712 Spectrum Analyzer	1230 Logic Analyzer	2510 TestLab Waveform Analyzer*1	370A Program Curve Tracer	371A Hi-Power Pgm. Curve Tracer	TM 5000 Modular Instrument	AFG5101 (Arb. Wfm. Gen.)	VXI/CDS Instruments	TSI 8150 Test System Interface	Instruments from other vendor	3052 Digital Signal Proc. System	2706 Stepping RF Preselector
			INSTRUMENTS SUPPORTED																													
TekTMS/IPG Interactive Procedure Generator	S3FT100	274	•			•	•	•	•																•		•		•			
TekTMS/RTG Run Time Generator	S3FT110	274	•			•	•	•	•																•		•					
TekTMS/FPE Front Panel Editor	S3FT120	274	•			•	•	•	•																•		•					
TekTMS GPIB/VXI Instrument Libraries	S3FT300/200	274	•			•	•	•	•																•		•					
LabWindows/Advanced Analysis Libs	S3FG910/912	274	•	•	•	•	•	•			•						•					*2			•	•	•		•			
LabView PC Windows	S3FG919	274	•	•	•	•	•	•		•	•	•	•				•						•	•					•			
LabView Sun SPARC	S3FG920	274	•	•	•	•	•	•		•	•	•	•				•						•	•					•			
WaveWriter®	S3FT400	282	•			•	•	•																		•	•		•			
TDS Data Manager S/W	S34TDS1	63	•																													
11000 Series DSO Utility	S47P108	283		•	•	•																										
222 Virtual Front Panel	CAT200	112								•																						
WaveSaver	S41SAVE	279							•																							
Integrated TeleServicing	S41TSS1	279							•																							
DCS01GPH Acquisition, Graphics and Analysis	062-9859-01	411												•	•	•													•			
DCSLib Functional Library	S58DC01	411												•	•	•													•			
DCSGEN	MUX16 Opt. 10	411												•	•						•	•										
1230/PC RS-232 Applications	S43R101	182																			•											
278X/PC Utility	S26UT00	209																•														
271X/PC Utility	S26UT10	209																		•												
Commercial EMI Test	S26EM12	212																•	•	•												•
EMI Prequalification	S26EM00	212																	•													
General RF Applications (GRASP)	S26RF00	209																	•													
Remote Site Monitoring (RSM)	S26RM00/01	209																	•													
370 Device Test	S48P401	398																					•									
370 Utility	S48P104	398																					•									
371 Utility	S48P105	400																						•								
UNIX Based																																
Frequency Enhancement S/W Utility	S2MG100	258																													•	

[1] The 2510 TestLab Analyzer writes waveform data to an integral MS-DOS formatted 3-1/2 in. flexible disk. The PC Utility software provided with the analyzer converts the data into various formats that are compatible with PC resident analysis programs including WKS format for spreadsheets and:

[2] ASCII format without header information.

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

ORDERING INFORMATION

GPIB INTERFACE CARDS

National Instruments PC-GPIB 8-bit interface, drivers and manual. Order S3FG210 ..... **$395**

National Instruments AT-GPIB 16-bit interface, drivers and manual. Order S3FG220 ..... **$450**

National Instruments MC-GPIB microchannel interface, drivers and manual. Order S3FG230 ..... **$450**

National Instruments GPIB drivers and manual for older PC2/PC2A. Order S3FG200 ..... **$225**

WaveSaver and Teleservicing Software

WaveSaver Documentation Package

WaveSaver is a new applications software package designed for use with Tektronix' 2221(A), 2224, 2230 and 2232 digital storage oscilloscopes and the IBM PC. In one easy-to-use package, WaveSaver enables you to quickly and easily transfer waveforms to and from your digital storage oscilloscope. With WaveSaver's pop-up menus you can:

- Transfer waveforms to and from the oscilloscope
- Display waveforms on the PC screen in EGA color graphics
- Store and retrieve waveform data to disk
- Add notes to the displayed waveforms
- Document waveform display via printer and HPGL-plotter (four-color) output
- Send numeric waveform data to a printer
- Read oscilloscope front-panel settings
- Change menu settings, re-arm single-shot trigger

REQUIRED EQUIPMENT

- Personal computer IBM PC XT or AT (or equivalent) with MS-DOS (V2.0 or later)
- 640K RAM
- Hard disk (or two 1.2 MB 5.25 in. or 760K 3.5 in. floppy disk drive)
- IBM MDA, CGA, or EGA graphics adapter and compatible monitor
- Tektronix DSO with Option 12 (RS-232-C interface)
- RS-232-C Cables (e.g. part number 012-0911-00 DB25-DB25 straight-through)

Tektronix' TeleServicing Software combines data communications, data management, and waveform graphics in one affordable, integrated package.

The Field Teleservicing Solution

For even more functionality, Tektronix' integrated TeleServicing Software combines the data management and waveform graphics of WaveSaver with modem communications.

With Tektronix TeleServicing Software, you can connect a compatible Tektronix digital storage oscilloscope (DSO) to an IBM PC-compatible system over an RS-232-C interface and standard telephone modems. The data communications function permits configuration of PC communication port, modem initialization, and direction of data to and from a remote scope or PC. Data management functions include file capture, storage, and retrieval.

FIELD SERVICE EFFICIENCY

Tektronix TeleServicing Software provides field-service technicians with immediate, low-cost access to expert consultation in the service center. With the 2232's 26K of extended waveform storage, you can create libraries of new or known-good waveforms for reference in troubleshooting applications.

DIRECT MONITORING

Remote monitoring of equipment in distant or hazardous sites is also facilitated with Tektronix TeleServicing Software. At the site, a technician can set up a scope in babysitting mode, connect it to a PC in the home office, and monitor problems from there.

DATA LOGGING

Tektronix TeleServicing is ideal for such data logging applications as trend analysis. It allows you to create reference waveform libraries, schedule preventative maintenance visits, and facilitate equipment installations.

REQUIRED EQUIPMENT

- Same as WaveSaver Software, plus
- Hayes-compatible 300/1200-baud modems

INSTRUMENT COMPATIBILITY

Same as Tektronix WaveSaver Software.

WAVESAVER

- Data Communications, Data Management, and Waveform Graphics in One Package
- Easy-to-Use Windows and Pop-up Menus
- Easy Creation of Reference Libraries

TELESERVICING SOFTWARE INCLUDES:

- Standard Phone Line and RS-232-C Link-up
- Built-in Phone Directory with 20 User-Definable Automatic Dialing Entries

Easy-to-use software for digital storage oscilloscopes.

TD

Call Direct – Product available within 24 hours, (through TekDirect only). Call 1-800-426-2200. Also available through an Authorized Tektronix Distributor (listed on page 540).

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

ORDERING INFORMATION

S41SAVE
WaveSaver Software ..... TD **$199**
Includes: Software (on 5.25 in. and 3.5 in. diskettes); User Manual (070-7875-00).

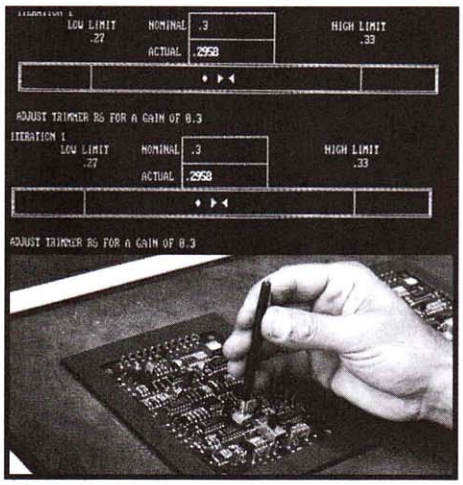
S41TSS1
Integrated TeleServicing Support Software ..... TD **$295**
Includes: Software (on 5.25 in. and 3.5 in. diskettes); User Manual (070-7466-00); Training Videotape (068-0296-04); Software subscription updated.

Test Development Software EZ-Test

Easy to use software development environment for DOS-based applications.

EZ–TEST TEST DEVELOPMENT SOFTWARE

- No Programming Required
- Develops and Runs Automated Tests with GPIB Instruments
- Generates Application Test Code in Microsoft QuickBASIC
- Reduces Test Development Time
- Executes Compiled Test Programs
- Runs on TekMate 2402A Instrument Controller and IBM XT/AT Compatible with Tektronix GPIB Interface
- Generator Program to Create, Edit, Debug, and Execute the Test Procedure
- Translator Program to Convert the Test Procedure to QuickBASIC Code, then Compile and Link
- Test Executive Program to Schedule and Run Compiled Test Procedures
- Microsoft QuickBASIC Editor, Compiler, and Linker Software Package



The adjustment step acquires measurements and displays them on screen relative to nominal and upper and lower test limits, simplifying UUT adjustment procedures.

EZ-TEST Test Development Software

A COMPLETE DEVELOPMENT AND TEST RUNTIME SYSTEM

EZ-TEST is a software productivity tool used to create and run test software for manufacturing, service repair and rework, metrology, and prototype evaluation.

Let the instruments create your software. EZ-Test learns the settings of GPIB instruments and generates program code automatically.

EZ-TEST is for non-programmers or programmers who prefer to concentrate on testing rather than software coding chores.

The EZ-TEST software system provides all the software necessary to develop and run test system programs. Figure 1 shows the major elements of EZ-TEST:

- Generator program to create, debug, and execute the test procedure.
- Translator program to convert the procedure to Microsoft QuickBASIC code and then compile and link it, resulting in a complete standalone test program.
- Test Execution Scheduler to run sequences of compiled tests and gather test data.
- Microsoft QuickBASIC editor, compiler, linker and manuals.
- GPIB interface software for QuickBASIC.

RUN TESTS WITH TEKMATE 2402A

EZ-TEST comes complete with runtime libraries to produce compiled test programs which run on the TekMATE 2402A with a 2400 Series Digital Sampling Oscilloscope.

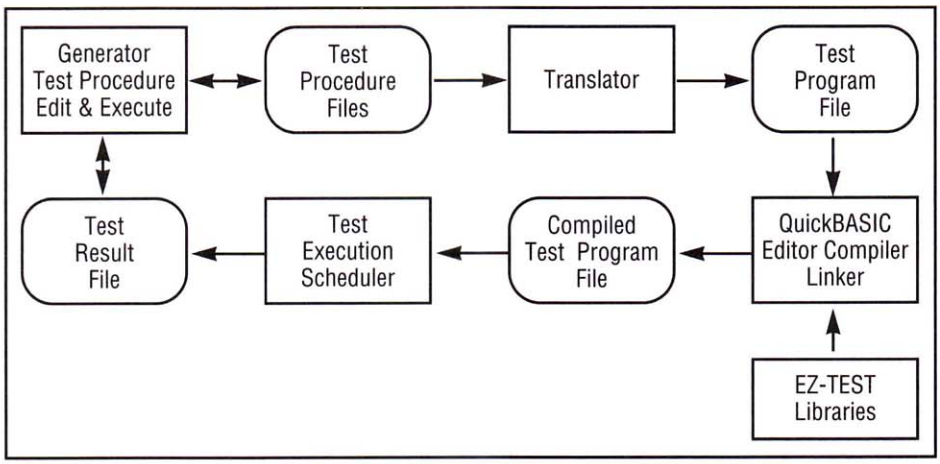
To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

Test Development Software EZ-Test

TEST FUNCTIONS
EZ-TEST provides a simple means to specify high-level test functions using instruments on-line. Create test procedures with these functions:

- Instrument control commands.
- Instrument measurement.
- PASS/FAIL limits for measurements, controls procedure process flow.
- UUT adjustment steps, measurement shown on screen with cursor moving relative to nominal and limits values for easy operator adjustment.
- Waveform acquisition and pulse parameter analysis with PASS/FAIL limits.
- Disk file transfers to and from instruments.
- Procedure WAIT states for instrument or UUT settling.
- Automatic Stimulus/Response testing.
- Graphical screens for operator instructions created with PC Paintbrush software from Microsoft.
- SRQ Interrupt handlers.
- Status BYTE acquisition.

Tektronix EZ-TEST PC Software System Elements



Tektronix EZ-TEST PC Software System.

INSTRUMENT SUPPORT
EZ-TEST supports Tektronix instruments with high-level functions for instrument setup and special measurement acquisitions.

- TM 5000 family of general purpose test instruments.
- Waveform acquisition and pulse parameter measurements for digitizers and digital oscilloscopes (7000, 11000, 2400, and RTD series).
- TSI 8150 Test System Interface configuration utility for fixture switch matrix programming.
- Instrument settings queries and standard measurements are supported for the full line of Tektronix GPIB instruments which feature the Tektronix Codes and Formats Standard for Programmable Instruments, including spectrum analyzers and logic analyzers.

EZ-TEST also supports generic setup and measurement capabilities for IEEE-488.1 compatible instrument with any combination of talker and listener capabilities.

Instrument driver software modules may be written in QuickBASIC and installed into EZ-TEST to provide additional instrument support.

ORDERING INFORMATION

SYSTEM ENVIRONMENT
EZ-TEST PC runs on the Tektronix 2402A system controller or on any IBM PC/AT or compatible computer configured with the Tektronix GPIB interface card (S3FG100 or S3FG120), and with 640 kBytes RAM, 5.25 in. or 3.5 in. DSDD floppy drive, hard disk and MS-DOS 3.0 or higher. A CGA graphics monitor (or better) and adapter is recommended for graphics displays.

S45F030
EZ-TEST **$995**
Opt. 06 – Delete Microsoft ..... **–$100**
QuickBASIC (required for international orders) *1

[1]Contact your local Tektronix representative for price information.

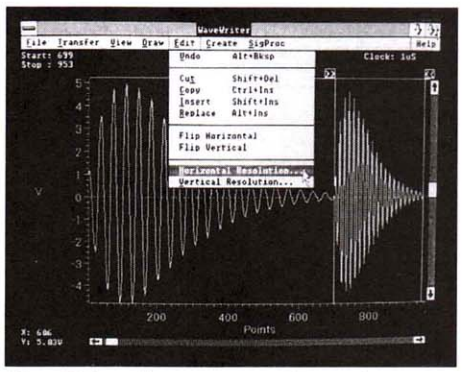
Product also available To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

Waveform Creation and Editing Software

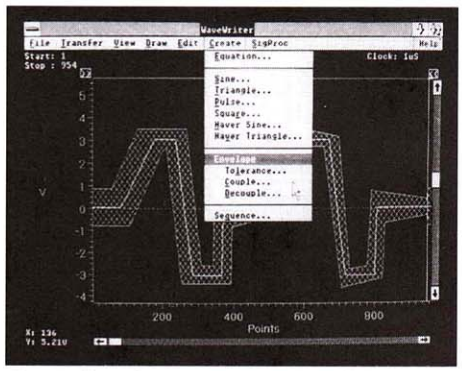
WaveWriter simplifies the creation and editing of waveforms for arbitrary waveform generators and digital oscilloscope templates.

WAVEWRITER™ ARBITRARY WAVEFORM GENERATION SOFTWARE

- Create and Modify Waveforms for AFG 5101/5501, VX5790, etc.
- Use WaveWriter Stand-Alone or Integrated into TekTMS
- See What You Are Doing As You Go
- Create Waveforms by Drawing Them (Freehand or with Autolining between Selected Points), by Editing Standard Functions, by Writing Equations, or by Capturing Them with a Scope
- Edit Waveforms by Cut and Paste Methods; or Invert, Add, Subtract, Multiply, or Divide Whole Waveforms or Portions
- WaveWriter Automatically Deals with Record Size, Resolution, etc., of Target Instruments
- Microsoft Windows-Based User Interface



WaveWriter allows easy creation and modification of custom waveforms.



Create the reference memory template waveform for pass/fail testing on 2400 Series Oscilloscopes.

WaveWriter Waveform Creation and Editing Software

WAVEFORM GENERATION

WaveWriter™ is the new software support package for creating and modifying arbitrary waveforms for the Tektronix Arbitrary Waveform Generators and digital oscilloscopes. WaveWriter represents a major step forward in allowing easy creation of the real world signals which are increasingly being used to test circuit tolerances, drive vibration/shake tables, and simulate other non-ideal or corrupted signals.

WaveWriter offers an easy to use alternative to general-purpose programming languages for waveform definition. Its user interface is based on Microsoft Windows™, with pull-down menus and mouse-selected icons. (Alternatively, you can use a command-driven interface.) It can work on its own, or as an integral part of TekTMS test program generation software.

ACQUIRE SIGNALS OSCILLOSCOPES

Signals may be acquired from the Tektronix 11000 Series, 2200 Series, 2400 Series oscilloscopes as well as the VXI digitizer VX5260. The signals may then be modified and recreated on the arbitrary waveform generators.

CREATE CUSTOM WAVEFORMS

Define waveforms by:

- Entering equations and limits,
- Drawing them freehand,
- Selecting endpoints of straight line segments,
- Editing standard functions, including sines, pulses, triangles, and haver functions,
- Uploading captured functions from a suitable digital oscilloscope.

EDIT WAVEFORMS GRAPHICALLY

By defining sections of a waveform with WaveWriter's markers (which work like the cursors on an oscilloscope display), you can perform mathematical functions, including inversion; scale vertically and horizontally; and cut and paste. For example, you can add harmonically related sinusoids to construct a signal from its Fourier components. Or, starting with a signal captured by an oscilloscope, you can add glitches and distortion to test a circuit's response to specific kinds of signal aberrations.

AUTOMATIC OUTPUT TO TARGET INSTRUMENTS

Users identify the target test instrument and the software handles details such as record length and precision, D-to-A clock rates or time base settings. WaveWriter supports a number of Tektronix AFGs, digitizers and scopes, and users can add instruments by responding to on-screen queries.

OSCILLOSCOPE TEMPLATE GENERATION

WaveWriter also supports the 2400 series line of digital storage oscilloscopes with template generation for the Save-On-Delta feature. Therefore, with WaveWriter, the user can create the exact tolerances or templates with which to capture a differentiated signal or identify a failure.

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

ORDERING INFORMATION

S3FT400
Tektronix WaveWriter System Software **$995**

WaveWriter is provided on both 1.2 MByte 5.25 in. and 1.44 MByte 3.5 in. diskettes.

Documentation and Data-Logging Software

11000 Series Utility Software

The 11000 Series Utility Software packages provide complete GPIB or RS-232-C control of the Tektronix 11000 Series oscilloscopes, CSA 803, CSA 404 or the DSA 600A Series Digitizing Signal Analyzers from your IBM PC.

These utility software packages allow you to use the full GPIB or RS-232-C programmability of the 11000 Series oscilloscopes without ever having to write a single line of code.

You get the simplest possible access to the measurement system power through each menu-driven package.

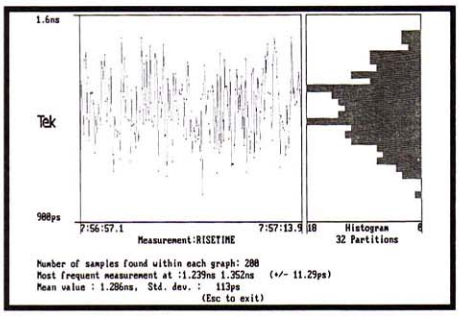
All of the major commands and functions are directly executed from the PC's function keys. You choose what you want to do from the first-level, main menu-acquire measurement data, copy settings, send GPIB interface commands, etc. Then a second-level menu appears, allowing you to select the specific functions or options for the operation or to enter controlling parameters or file names. Required entries from the keyboard are always prompted and are in a simple "fill-in-the-blanks" format.

No matter what you select or enter, the utility software packages will perform thorough error checking to help ensure the job is done correctly. Also, if there is any ambiguity or error in entries, the packages provide automatic prompting for immediate on-line correction.

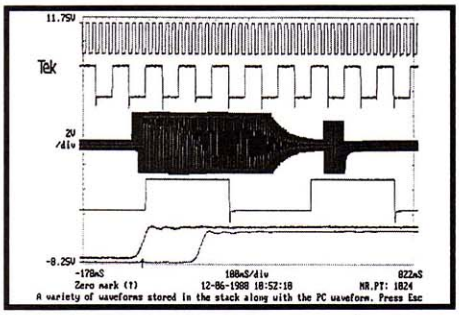
If there is ever any question about program operation, simply press F9. This provides complete on-screen help from any menu.

BASIC HARDWARE CONFIGURATION

IBM PC, XT, or AT; and DOS 2.0 or above – compatible with 640K memory; dual floppy drive or one floppy and one hard disk; graphics card; National Instruments IBM PC GPIB card (for GPIB operation); GPIB cable or a 9-wire RS-232-C cable.



Measurement features of the 11000 Series DSOs are available through the menus and are supported by measurement logging, statistics, and screen graphics.



Multiple waveforms can be acquired and displayed on the PC screen and output to a plotter or dot-matrix printer.

11000 SERIES UTILITY SOFTWARE

- Archival Storage of Waveforms and Settings
- Automated and Manual Logging of Measurement Data
- Measurement Data Graphs and Histograms
- GPIB and RS-232-C Instrument Control
- Waveform Acquisition and Display or Template Waveform Creation
- Hard Copy (Printer or Plotter)
- BASIC Source Code

Complete GPIB or RS232-C control of Tektronix 11000 Series, CSA 803, CSA 404, or the DSA 600A Series instruments from your IBM PC.

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

ORDERING INFORMATION

S47P108
11000 Series DSO Utility Software **$495**
Includes: Software Operator Manual (070-7394-00).

Test and Measurement Instruments

Modular and Standalone

Test and Measurement Instruments

Tektronix Test and Measurement instruments provide the answers to a broad range of test and measurement needs. We offer a wide variety of general purpose test instruments targeted at Benchtop & ATE system solutions. We offer products configured as modular instruments in our TM 500/TM 5000 series or as standalone instruments in our Signal Sources product families.

Our standalone Signal Sources products are designed using the latest technologies and consist of Pulse Generator, Function Generator, and our NEW Arbitrary Generator product families. These products are designed for precision, high performance applications and implement Graphics User Interfaces (GUI) for simplified operation. The interface has been designed with display menu listings and "Soft Key" selection controls placed in consistent, predictable locations. The advanced functions which extend functionality and increase operator productivity are easy to learn and use.

These powerful new products reduce test stand requirements with high levels of circuit integration. They combine many of the features typically found in automated test stands which rely on software and controllers to solve specific test problems. The result is a family platform which establishes new benchmarks in ease of use in high performance applications. Utilization of high density surface mount technologies have facilitated these highly integrated product designs.

The Tektronix TM 500 line of manual instruments lets you create just the system you need and all TM 500 instruments are electrically and mechanically compatible with the TM 5000 GPIB programmable instruments. They can be used in TM 5000 mainframes side-by-side with the TM 5000 programmables. This compatibility yields cost effective solutions to system applications where not all functions or measurements need to be programmable.

You can choose from over 50 compact plug-ins to create multi-function packages for a wide range of applications, or to solve unique application problems. These modular instruments function individually or as part of a computer-controlled network.

The TM 5000 programmable instruments are designed for ease of use and flexibility in automated testing and measurement applications. You get the benefits of advanced programming capability, complex interfacing, and compactness as standard features.

Programming is simple because TM 5000 instruments are GPIB compatible and support Tektronix' Standard Codes and Formats, assuring the language and syntax between instruments are consistent and easy to use. Standardized instruments-data formats open up the lines of bus communication and make your test and measurement system easy to set up and operate.

For the TM 500 line of manual instruments, there's a travel mainframe for service work and field testing; a rack mount model for production test; or standard mainframes, compact and convenient for bench or desk, that accept one to six instruments.

The TM 5000 instruments operate in either TM 5003 or TM 5006A mainframes to form compact, configurable, automated test systems that occupy less than half the rack space of ordinary rack mounted equipment and decrease the number of GPIB cables and power outlets. One cable and one power cord per main frame are all that is required. The TM 5003 has three compartments, the TM 5006A has six. All TM 5000 and many of the TM 500 instruments are UL listed.

Adherence to standard form and fit means that any TM 500/TM 5000 instruments can be replaced in a system without the uncabling, unstacking, restacking, and recabling that is necessary with most instruments. Rebuilding the system for different tasks takes seconds, not hours.

The TM 500/TM 5000 line of modular instruments is designed so connections between modules and/or external equipment can be made by the mainframe rear interface board and optional rear-panel connectors.

While the connections can be made in each of the mainframes, ordering the rear interface (Option 02) provides the BNC connectors for the rear panel.

CONTENTS

SIGNAL SOURCES
Arbitrary Generators 286
Function Generators 298
Pulse Generators 306
Programmable Stimulus System 314

POWER SUPPLIES 317

MEASUREMENT INSTRUMENTS
Digital Multimeters 320
Digital Counters 326
Digital Prescaler 332
Modular Oscilloscopes 336

INTERFACE TOOLS
Scanners 341
Plug-in Kits 357

AUDIO ANALYSIS
General Information 342
Audio Oscillators 344
Distortion Analyzers 346

SIGNAL CONDITIONERS
Differential Amplifier 348
Operational Amplifier 349
Time to Voltage Converter 350

MAINFRAMES & ACCESSORIES
General Information 351
TM 5000 Mainframes 353
TM 500 Mainframes 354
Accessories 356

OSCILLOSCOPE CALIBRATORS
General Information 358
Calibration Instruments 362
Calibration Systems 366

Arbitrary Generators

CONTENTS

ARBITRARY GENERATORS
General Information 286
AWG 2020 288
AFG 2020 288
AWG 5105 292
AFG 5102 295
AFG 5502 295
AWG 5102 295
AWG 5502 295

Arbitrary Waveform Generators

At Tektronix, Arbitrary waveform generation concepts have been around for several years. Starting in the first generation as simple Digital to Analog Converters (DAC) on a card for systems applications where separate memory cards and function generation cards could extend the operational capabilities when combined with software and a system controller. Over the years, these system components have evolved into a single second generation product known today as: Arbitrary Waveform Generators, Arbitrary Function Generators, and Direct Digitally Synthesized Generators, Tektronix offers all three of these designs. Tektronix has defined these distinctive designs as follows:

Arbitrary Generators – Generically refers to all arbitrary waveform sources regardless of digital technologies.

Arbitrary Waveform Generators (AWG) – Refers to sources which convert digital information into analog waveforms. These products utilize digital memories for waveform storage and execution.

Arbitrary Function Generators (AFG) – Include AWG capabilities plus either standard Analog or Synthesized Standard waveforms (sine, square, triangle, ramp up or down, and DC). Some of the products also include built-in sweepers.

Direct Digital Synthesizers (DDS) – Optimized for generation of synthesized standard waveforms which offer limited Arbitrary Generation capability.

TM 5000 SERIES

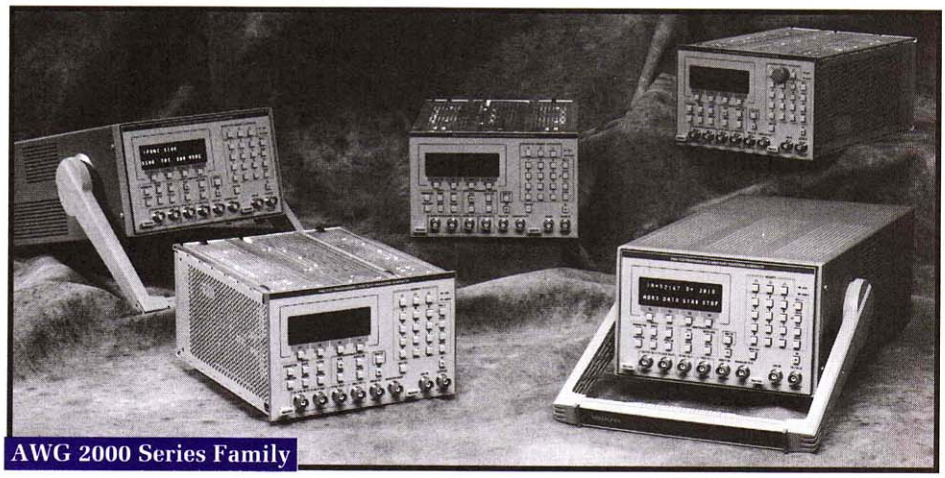
Available as Plug-in (AWG 5100 or AFG 5100 Series) modules designed into the popular TM Series architecture for benchtop or systems applications and available as stand alone (AWG 5500 or AFG 5500 Series) monolithic packages for the cost conscious. Recommended DSOs for optimal systems applications include: 2200 Series, 2400 Series and TDS Series products.

The AWG 5000 Series Arbitrary Waveform Generators provide users with the best price/performance for applications not requiring standard analog functions or sweep generation. These products have clock rates ranging from 20 MS/s to 50 MS/s and offer external clock capabilities for phase synchronous or frequency agile applications. Dual channel outputs available with the AWG 5105 make this product ideal for 3 phase power, Automotive ABS, Communications and multi-channel Process Control applications.

The AFG 5102/5502 Series Arbitrary Function Generators are three generators in one. They incorporate (1) an Arbitrary Waveform Generator (2) an independent Analog Function Generator for Standard waveforms (sine, square, triangle, ramp up or down, and DC) and (3) a sweep generator which provides linear, logarithmic and a unique Arbitrary sweep of the output waveform.

NEW! 2000 SERIES ARBITRARY GENERATORS, COMPLEX WAVEFORM SYSTEMS

Tektronix is now introducing the Third Generation of these flexible signal sources which virtually remove the requirements for system controllers and software for Waveform Generation in some benchtop applications. While these products are classified as Arbitrary Generators they are truly Waveform Simulation Systems. They consist of built in High Resolution video monitors, and MS-DOS style waveform file management system, direct waveform transfers to and from Digital Storage Scopes, built-in mass data storage, and ASCII Waveform file transfers via GPIB IEEE 488.2 or by a built-in 3.5 inch floppy media and much more! Their direct waveform transfer capability optimizes these products in applications utilizing the Tektronix 2200, 2400, and TDS Series DSOs.



AWG 2000 Series Family

Arbitrary Generators

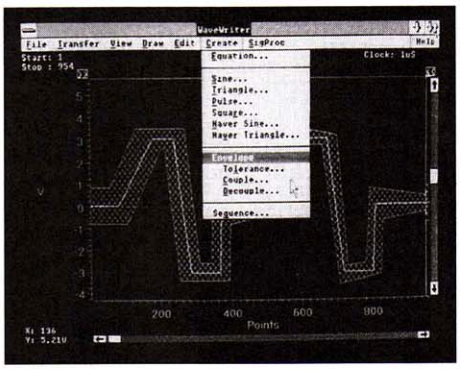
The AWG 2020 is targeted at applications requiring long memory length waveforms (256 k) with 12 bit vertical resolution at 250 MHz. Waveform editing is greatly enhanced via the ICON driven Graphic Use Interface (GUI) which allows real time viewing on the high resolution display during waveform editing. Advanced features like waveform sequencing and polynomial entry provide additional waveform flexibility not previously available.

The synthesized AFG 2020 utilizes the New, state of the art, DDS Direct Digital Synthesis method of waveform creation. The product excels in low phase noise, high frequency accuracy SYNTHESIZER applications.

ARBITRARY WAVEFORM GENERATION SOFTWARE

WaveWriter/AWG™ is the new software support package for capturing, creating and modifying arbitrary waveforms for Tektronix Arbitrary Generators. WaveWriter represents a major step forward in allowing easy creation of the complex signals which are increasingly being used to test circuit tolerances, drive vibration/shake tables, and simulate transducers other non-ideal or signal anomalies.

WaveWriter also supports Tektronix digital storage oscilloscopes with template generation for the Save-On-Delta feature. Therefore, with WaveWriter, the user can create the exact tolerances or templates with which to capture a differential signal or identify a failure.



APPLICATION TABLE

	General Purpose	Computer	Communication	Industrial	Semiconductor
AWG 5102					
AWG 5502	X	X		XXX	
AFG 5102					
AFG 5502	XXX	X	X	XXX	
AWG 5105	XXX	XXX	XXX	XXX	X
AFG 2020	XXX	X	XXX		XX
AWG 2020	X	XXX	XXX		X

ARBITRARY GENERATORS SELECTION GUIDE

Vendor/Model	AWG 2020	AFG 2020	AWG 5105	AFG 5102/5502	AWG 5102/5502
Sample Rate	250 MS/s	250 MS/s	50 MS/s	20 MS/s	20 MS/s
Time Base Accuracy	50 ppm	1 ppm	0.02%	50 ppm Synth on	0.02%
Vertical Res. (bits)	12	12	12	12	12
Sine, Sqr, Tri, Ramp, DC	Synthesized Only	Via DDS Technology 100 MHz Sine: 50 MHz others	Synthesized Only 3 MHz	Yes; Full Analog FG 20 MHz – .02 Hz	Synthesized Only 1 MHz
Execution Memory	256K pts/CH	1K pts/CH	64K pts/CH	32K pts	32K pts
Non-Volatile Memory	160K Settings	16K/16 Settings	256K pts	32K pts	32K pts
Memory Sequencing	8K pt Wfm 400 waveforms	16K/16 Settings	NA	NA	NA
Graphic Waveform Editing	Yes, equation, STD, Draw Timing, Table.(03.FFT)	Yes, equation STD, Draw 91	Line Draw/Pre Def	Line Draw/Pre Def	Line Draw/Pre Def
Output Channels	1 CH	1 CH	1 CH	1 CH	1 CH
Add a CH Option	Opt. 02	Opt. 02	Opt. 02	NA	NA
Amplitude Vp-p into 50 ohm	5 V	10 V	15 V to 15 mV	15 V to 15 mV	10 V to 10 mV
Package Format	Monolithic	Monolithic	TM 5000 Plug-in	TM5000 or Monolithic	TM5000 or Monolithic
Ext Clock	Ref. Clk IN/OUT	Ref. Clk IN/OUT	Clk IN/OUT	Clk IN/OUT	Clk IN/OUT
Modulation	AM/FM/PSK/FSK Offset: 1 Hz-100 M	AM/FM/PSK/FSK Offset: 1 Hz-100 M	AM (FM variable clk)	AM/FM	AM (FM variable clk)
Built-in Sweeper		Linear/Log	NA	Lin/Log/Arbitrary	NA
Media Storage	3.5 in. Floppy	NA	NA	NA	NA
Direct DSO Transfer	Yes, 2200, 2400/TDS	Yes, 2200, 2400/TDS	NA	NA	NA
GPIB Bus Monitor	Yes	NA	NA	NA	NA
IEEE Standard	IEEE 488.2	IEEE 488.2	IEEE 488.2	IEEE 488.1	IEEE 488.1
Software Support					
WaveWriter/AWE	Yes	Yes	Yes	Yes	Yes
***1 R4**				Yes	Yes
***2 Lab Windows**	Yes	Yes	Yes	Yes	Yes
Prices begin at	**$11,995**	**$7,995**	**$5,995**	**$3,995/$4,795**	**$2,995/$3,795**

**1 Rapid Systems software package*
**2 National Instruments software package*

Arbitrary Generators

Signal Sources

Couple these ARB's with our 2200, 2400 or TDS Series Digital Scopes for complete test application requirements. Additional flexibility with the AWG 2020 built-in controller and 3.5 inch PC compatible disk.

AWG 2020

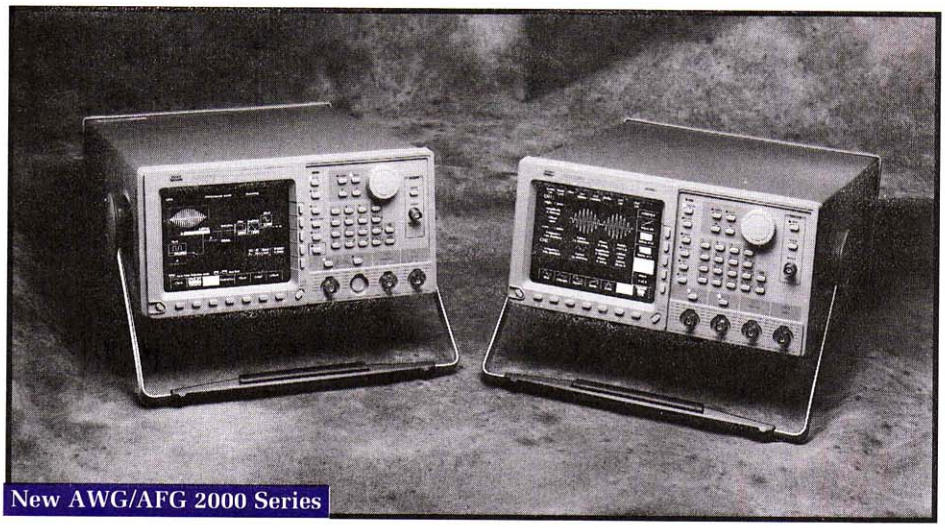
- Arbitrary Waveform Generation
- 256K (262,144 Points) Record Length
- Built-in PC-Compatible 3.5 in. 1.4 Mbyte Floppy Disk for Storage and Transfer
- Digital Signal Processing (Opt. 09)
- 12-bit Digital Output (Opt. 03)
- DOS-like Waveform File Management
- Formula Entry of Parameters for Mathematically Precise Waveforms

AFG 2020

- Synthesized Arbitrary Function Generation using Direct Digital Synthesis Techniques
- 1K (1024 points) Record Length
- 100 MHz Sinewave Generation
- 50 MHz Square Wave
- 31.2 MHz Triangle, Ramp, and Pulse
- AM/FM/PSK/FSK Modulation
- Built-in Linear/Log Sweep

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

GPIB IEEE-488 — The AWG 2020 and AFG 2020 complies with IEEE Standard 488.1/488.2-1987, and with Tektronix Standard Codes and Formats.



New AWG/AFG 2000 Series

New AWG/AFG 2000 Series

The Tektronix AWG 2020 and AFG 2020 Arbitrary Generators combine the function of an arbitrary generator with a controller and a graphical user interface. A built-in high-resolution monitor facilitates waveform definition.

The AWG 2020 and AFG 2020 share a common user interface design and monolithic platform. While the basic operation is similar, each unit provides unique benefits. The AWG 2020 is ideal for generating complex waveforms requiring long record lengths – up to 256K. It also includes a built-in 3.5 inch floppy disk to facilitate data storage and waveform transfers. An MS-DOS compatible file management system allows waveform generation and transfer without an external controller for most operations.

The AFG 2020 is ideal for applications requiring both precision functions and limited arbitrary waveform generation. It uses Direct Digital Synthesis (DDS) to generate highly accurate waveforms that can be defined in a 1K record length. It can generate standard sinewaves up to 100 MHz, square waves up to 50 MHz, and triangle, ramp, and pulse waveshapes up to 31.2 MHz.

GENERATE A VARIETY OF WAVEFORMS WITHOUT A CONTROLLER

Standard waveshapes available include sine, square, triangle, ramp, pulse, and DC. Coupled with flexible triggering, gating, and modulation capabilities, you have complete control over waveform generation. In addition, you can precisely define waveforms using polynomial formula entry of mathematical parameters.

GRAPHICAL USER INTERFACE SIMPLIFIES OPERATION

A unique windows-like graphical user interface (GUI) provides a familiar user environment and simplifies operation. The icon-based GUI features soft-key menu selections. As you enter data to build your waveform, you can view the resultant signal on the integral display.

USE STANDARD WAVEFORMS OR CREATE YOUR OWN

You can use any of several methods to create a new arbitrary waveform. You can select one of the standard waveshapes from the library and modify it to produce the desired waveshape using the graphical waveform editing tools. Or, waveforms can be acquired with a companion digital oscilloscope (DSO) and transferred to the AWG 2020 or AFG 2020 via the GPIB – an external controller is **not** required for transfer. A series of waveforms can be executed via the internal DOS-like file manager.

Unique waveforms can be created in exacting detail using the graphical editing features to define waveshapes. Or you can use the formula entry mode to precisely define waveforms based upon mathematical equations, timing diagrams, or timing tables.

THE PERFECT COMPANION FOR YOUR TEKTRONIX SCOPE

The AWG 2020 and AFG 2020 feature direct communication with the Tektronix 2200, 2400, and TDS series digitizing oscilloscopes. Waveforms acquired with these scopes can be transferred to the AFG 2020 or AWG 2020, edited for desired features, and used as testing sequences. All of this can be done without the need for an external controller.

FULLY PROGRAMMABLE VIA GPIB

The AWG 2020 and AFG 2020 are fully programmable via a GPIB interface (IEEE 488.2). As a result, they are ideal additions to provide stimulus and arbitrary waveform generation for your measurement system.

Arbitrary Generators
Signal Sources

AWG 2020 Characteristics

SYNTHESIZED WAVESHAPES
Sine, square, triangle, ramp, pulse, arbitrary, and DC.

ARBITRARY WAVEFORMS
Waveform Memory – Memory Length: 256K x 12 bits for waveform data; 256K x 1 bit for Marker 1 data; 256K x 1 bit for Marker 2 data. Waveform: 64 to 256K in multiples of 8 data points.

Sequence Memory – 8K.

Scan Counter – 1 to 64K (16 bits).

Burst Counter – 1 to 64K (16 bits).

RATE CLOCK
Frequency Range – 10 Hz to 250 MHz.

Display – 4 digit.

Accuracy – +10°C to +40°C: 0.01%. +15°C to +30°C: 0.005%.

Resolution – 0.1% to 0.01% typical.

Skew between CH 1 and CH 2 (Opt. 02 only) – Within 4 ns.

MAIN OUTPUTS
Amplitude (excluding ADD and Multiply Operation) – Range: 0.05 V to 5 Vp-p into 50 Ω. Resolution: 1/4096 (12 bits). DC Accuracy: 0.05 V to 0.5 V, ±(0.5% of amplitude +5 mV); 0.501 V to 5 V, ±(1% of amplitude +25 mV).

Offset – Range: –2.5 V to +2.5 V into 50 Ω, (–100 mA to +100 mA). Resolution: 0.2 mA. Accuracy: ±(1% of offset +0.2 mA).

Pulse Response – +15°C to +30°C: Flatness, within 3% after 20 ns from rise/fall edges; Aberrations, within 7% +10 mV. +10°C to +40°C: Rise/Fall Time, <4 ns; Flatness, within 5% after 20 ns from rise/fall edges; Aberrations, within 9% +10 mV.

Impedance – Typically 50 Ω.

Harmonic Distortion (at 250 MHz clock, 0.5 V amplitude, 5000 points for sinewave data, no offset, no filter) – Second Harmonics: At least –40 dBc. Third Harmonics: At least –50 dBc.

OPERATING MODES
Continuous – Output continuous at programmed waveshape, frequency, amplitude, and offset.

Triggered – Output quiescent until triggered by an external, GPIB, or manual trigger; then generates a sequence only one time.

Gated – Same as triggered mode except period is executed only for the duration of the gated signal until the sequence started is completed.

Burst – Output quiescent until triggered by an external, GPIB, or manual trigger; then generates "n" sequences or cycles.

Waveform Advance – Continuously generates the waveform in the predefined sequence; the next trigger advances to the next waveform in the sequence.

Autostep – Generates the predefined waveform in the Autostep File; the next trigger advances the waveform.

ARITHMETIC OPERATION
AM (Multiply) (Opt. 02 only) – Output: Within 5%. Frequency Response: DC to 30 MHz.

External AM – Sensitivity: 2 Vp-p (±5%) signal produces 100% modulation. Frequency Response: CH 1, DC to 30 MHz; Ext Signal, DC to 4 MHz.

Add (Opt. 02 only) – Output: Within 5%. Frequency Response: DC to 30 MHz.

FILTERS
3 dBcutoff frequency – 1 MHz: Within 20%. 5 MHz: Within 20%. 20 MHz: Within 20%. 50 MHz: Within 20%.

Delay – 1 MHz: Typically 390 ns. 5 MHz: Typically 78 ns. 20 MHz: Typically 18 ns. 50 MHz: Typically 11 ns.

AUXILIARY OUTPUTS
Sync – Amplitude: 1 V ±0.3 V typical into 50 Ω. Impedance: 50 Ω typical. Sync to Signal Delay: Within 15 ns.

Marker 1 – Amplitude: 1 V ±0.3 V typical into 50 Ω. Impedance: 50 Ω typical. Marker to Signal Delay: Within 15 ns.

Marker 2 – Amplitude: 1 V ±0.3 V typical into 50 Ω. Impedance: 50 Ω typical. Marker to Signal Delay: Within 15 ns.

Clock – Amplitude: 1 V ±0.3 V typical into 50 Ω. Impedance: 50 Ω typical.

Digital Data Out (Opt. 03 only) – Level: ECL compatible. Output Signals: Data (D0 to D11). Skew Between Data: Within 1 ns. Clock to Data Delay: Within 3 ns. Connector: 68-pin mini-D sub.

AUXILIARY INPUTS
Trigger – Threshold Level: –5 V to +5 V. Resolution: 0.1 V. Accuracy: ±(5% x Level + 0.1 V). Pulse Width: 15 ns minimum. Input Swing: 0.2 V minimum. Maximum Input Volts: 10 Vp-p when 1 MΩ selected; 5 V RMS when 50 Ω selected. Impedance: 1 MΩ with 30 pF max. Trigger to Signal Delay: Internal Clock, 100 ns maximum; External Clock, 100 ns maximum +1 clock. Trigger Holdoff: 1 sec maximum (except Auto Step Mode).

AM – Range: 2 Vp-p (–1 V to +1 V) for 100% modulation. Maximum Input: ±5 Vp-p, 10 kΩ typical impedance.

Clock – Threshold Level: 0.3 V ±0.1 V typical. Input Swing: 0.8 V minimum. Pulse Width: 2 ns minimum. Maximum Input Voltage: ±2 Vp-p. Impedance: 50 Ω typical. Frequency Range: Up to 250 MHz.

PROGRAMMABLE INTERFACE
GPIB – IEEE-488.2-1987 compatible.

AFG 2020 Characteristics

WAVESHAPES
Sine, square, triangle, ramp, pulse, and arbitrary.

FREQUENCY/PHASE (SYNTHESIZER ON)
Clock – 250 MHz.
Frequency – 10 digits. Range: Sine, 0.5 Hz to 100.00 MHz; Other, 0.5 Hz to 2.5 MHz. Resolution: 0.5 Hz. Accuracy: ±(Reference Oscillator Accuracy + 0.12 Hz).
Period – Same digit as frequency, 2.0 sec to 10.00000000 ns.
Points/Cycle – 5 digits, 250 MHz divided by frequency for <100 MHz, up to 1024 or 2048.
Phase – 4 digits. Range: ±360°. Resolution: 0.1°.

FREQUENCY/PHASE (SYNTHESIZER OFF)
Frequency – 3 digits. Range: Square, 0.500 Hz to 50.00 MHz; Other, 0.500 Hz to 31.2 MHz. Accuracy: ±0.1%.

Period – Same digit as frequency, 2.00 sec to 40.0 ns.

Points/Cycle – 5 digits.

Clock/Rate – 512 Hz to 250 MHz.

AMPLITUDE/OFFSET
Amplitude – 4 digits. Resolution: 0.4 Vp-p, 1 mVp-p; 2 Vp-p, 2 mVp-p; 10 Vp-p, 10 mVp-p. Max. Amplitude: 10 Vp-p into 50 Ω; 20 Vp-p open circuit.

DC Accuracy – Range: 0.4 Vp-p, ±(1.0% of setting +1 mVp-p); 2.0 Vp-p, ±(1.0% of setting +5 mVp-p); 10 Vp-p, ±(2.5% of setting +50 mVp-p).

Offset – 4 digits. Resolution: 0.4 Vp-p, 1 mV; 2 Vp-p, 2 mV; 10 Vp-p, 10 mV. Max Offset: ±5 V into 50 Ω; ±10 V open circuit. Accuracy: 0.4 Vp-p, ±(1.0% of setting +1 mV); 2.0 Vp-p, ±(1.0% of setting +5 mV); 10 Vp-p, ±(2.5% of setting +50 mV).

Noise Floor – Range: 0.4 Vp-p, –128 dBm/Hz at 10 MHz; 2.0 Vp-p, –114 dBm/Hz; 10 Vp-p, –100 dBm/Hz.

Arbitrary Generators

Signal Sources

SINE

Maximum Points – 2048; 1024 with synthesizer off.

SSB Phase Noise – Synthesizer On: –90 dBc/Hz. Synthesizer Off: –80 dBc/Hz.

Harmonics – Synthesizer On with 100 MHz LPF:

	10 Vp-p	2 Vp-p, 0.4 Vp-p
<100 kHz	–40 dBc	–60 dBc
1 MHz	–40 dBc	–55 dBc
10 MHz	–35 dBc	–55 dBc
100 MHz	–25 dBc	–30 dBc

Synthesizer Off with 50 MHz LPF:

	10 Vp-p	2 Vp-p, 0.4 Vp-p
<100 kHz	–40 dBc	–55 dBc
1 MHz	–40 dBc	–55 dBc
10 MHz	–35 dBc	–40 dBc
100 MHz	–35 dBc	–40 dBc

Spurious –

	Synthesizer On	Synthesizer Off
<50 kHz	–60 dBc	–55 dBc
500 kHz	–55 dBc	–55 dBc
5 MHz	–45 dBc	–45 dBc
31.2 MHz	–40 dBc	–35 dBc
50 MHz	–40 dBc	
100 MHz	–30 dBc	

Amplitude – Flatness: Synthesizer On with 100 MHz LPF

	10 Vp-p	2 Vp-p, 0.4 Vp-p
≥100 kHz to ≤50 MHz	±0.5 dB	±0.5 dB
≤100 MHz	±1.0 dB	±0.5 dB

Synthesizer Off with 50 MHz LPF

	All
≥100 kHz to ≤10 MHz	±1.0 dB
≤31.2 MHz	±3.0 dB

Accuracy: 0.4 Vp-p and 2.0 Vp-p, DC accuracy ±3.0% + Flatness; 10 Vp-p, DC accuracy ±5.0% + Flatness. Power: 4 digits up to 23.98 dBm.

SQUAREWAVES

Maximum Points – 2048; 1024 with synthesizer off.

Amplitude – Flatness:

	50 MHz LPF	Full Pass
≤100 kHz to	±2.0%	±2.0%
≤2.5 MHz	±5.0%	±5.0%
≤15.6 MHz	±5.0%	±5.0%
≤50 MHz	–30%	±10%

Accuracy: DC accuracy ±2% + Flatness.

Rise/Fall Time – With 50 MHz LPF: Within 9.0 ns. With Full Pass: Within 4.0 ns.

Aberrations – With 50 MHz LPF: 0.4 Vp-p and 2 Vp-p, within 5% + 2 mVp-p; 10 Vp-p, within 7% + 10 mVp-p. With Full Pass: 0.4 Vp-p and 2 Vp-p, within 7% + 2 mVp-p; 10 Vp-p, within 12% + 10 mVp-p.

TRIANGLE WAVES

Maximum Points – 2048; 1024 with synthesizer off.

Amplitude – Flatness with 50 MHz LPF: ≤100 kHz, ±2.0%; ≤2.5 MHz, –7.0%; ≤15.6 MHz, –20%; ≤31.2 MHz, –40%. Accuracy: DC accuracy ±4.0% + Flatness.

RAMP

Maximum Points – 1024.

Timing – Rise/Fall: 4 digits, 0% to 100% of period.

Amplitude – Flatness with 50 MHz LPF: ≤100 kHz , ±2.0%; ≤2.5 MHz, –8.0%; ≤15.6 MHz, –25%; ≤31.2 MHz, –45%. Accuracy: DC accuracy ±4.0% + Flatness.

PULSE

Maximum Points – Gaussian: 2048; 1024 with synthesizer off. Exponential: 1024. Linear: 2048; 1024 with synthesizer off.

Pulse Width – 20% to 50.0% of period.

Transition – 0% to 35.0% of pulse width.

Amplitude – Flatness with 50 MHz LPF: ≤100 kHz , ±2.0%; ≤2.5 MHz, –5.0%; ≤15.6 MHz, –5.0%; ≤31.2 MHz, –20%. Accuracy: DC accuracy ±2% + Flatness.

ARBITRARY

Maximum Points – Any periodic waveform described with 12 bits and 1024 points.

Number of Waveforms – 16.

SWEEP

Spacing – Linear, log.

Frequency – 5 digits. Start, stop: Sine, 1.0 Hz to 100 MHz; Others, 1.0 Hz to 2.5 MHz.

Step (Linear) – Within 2.5 MHz, 5 digits.

Points/decade (Log) – 10 to 1000, 1-2-5 sequence; 1.0 Hz to 10 Hz, ≤10; 10 Hz to 100 Hz, <100; 100 Hz to 1 kHz, <1000; 1 kHz to 100 MHz, ≤1000.

Dwell Time – 4 digits. Sweep: 0.5 µs to 100 sec. Return: 0.5 µs to 100 sec.

Marker – Number: 3. Frequency: Between Start and Stop. Time: 0.5 µs to 100 sec.

Points – Sweep: 2 to 5001. Return: 1 to 5000.

Maximum Period – 2048 seconds ≤ Sweep + Return Time.

MODULATION

Amplitude Modulation – Amplitude: 4 digits, –10.00 Vp-p to +10.00 Vp-p. External CH 2 Amplitude, 1 Vp-p typical. Depth: 3 digits, 0 to 100%. Double Sideband Suppressed Carrier: ON/OFF. Modulation Rate: Period, 10 µs to 1 sec every 0.2 µs; Accuracy, ±0.1%. Risetime: Within 2 µs. AM Noise: Within 1% of range.

Offset Modulation – High, Low: 4 digits, –5.000 Vp-p to +5.000 V. Modulation Rate: Period, 10 µs to 1 sec every 0.2 µs; accuracy, ±0.1%. Risetime: Within 2 µs. Modulation Noise: Within 1% of range.

Frequency Modulation – Center Frequency: 9 digits. Deviation: 6 digits. Modulation Rate: Period, 10 µs to 1 sec every 0.2 µs; accuracy, ±0.1%.

Frequency Shift Keying (FSK) – Key: Number of Keys, 2 to 256: Frequency, within 100 MHz (sine) or 2.5 MHz (other); Amplitude, within 10 Vp-p; Offset, within ±5 V. Data: Number of Data, 2 to 2,048. Frequency Transition Time: 4 ns. Data Rate: 1 to 2,500,000; Period, 1 sec to 0.4 µs, every 0.1 µs.

Phase Shift Keying (PSK) – Key: Number of Keys, 2 to 256: Phase, within ±360.0°; Amplitude, within 10 Vp-p; Offset, within ±5 V. Data: Number of Data, 2 to 2,048. Phase Transition Time: 800 ns (200 clocks). Data Rate: 1 to 50,000; Period, 1 sec to 20 µs, every 0.1 µs.

CLOCK

Reference Oscillator – Type: TCXO. Nominal Frequency: 10 MHz. Accuracy: ±1 ppm (0°C ~ 50 °C). Stability: ±1 ppm/year (20°C ~ 30°C).

MAIN OUTPUT

Filters – 100 MHz Brick Wall: Within 1 dB to 100 MHz; less than –40 dB, 125 MHz to 1 GHz. 50 MHz Linear Phase: –3 dB ±0.5 dB at 50 MHz.

Output Impedance – 50 Ω typical.

Output Protection – The instrument is non-destructively protected against short circuits or accidental voltage of up to ±5 VDC plus peak AC applied to the main output connector.

AUXILIARY OUTPUTS

Sync Output – Positive TTL level. Min. Pulse Width: 400 ns. Output Impedance: 51 Ω nominal.

Marker Output – Positive TTL level. Min. Pulse Width, 100 ns. Output Impedance: 51 Ω nominal.

10 MHz Output – TTL level square wave. Duty Cycle: 50% to 75%. Output Impedance: 51 Ω nominal.

Arbitrary Generators
Signal Sources

AFG 2020
AWG 2020

AUXILIARY INPUTS

Trigger/Gate In – Sensitivity: 200 mVp-p min. Bandwidth: DC to 10 MHz. Amplitude: 30 ns, 200 mVp-p amplitude. Input Impedance: 1 kΩ ±5%. Max. Input Voltage: ≤10 VDC + peak AC. Threshold: Positive slope for Arming and Time Burst, and positive true for Gate. Negative slope for Arming and Time Burst, and negative true for Gate. Range: ±9.90 V. Resolution: 0.1 V. Accuracy: ±10% ±100 mV.

AM Input – Input Impedance: 10 kΩ ±5%. Max. Input Voltage: 10 VDC + peak AC.

REF IN – TTL compatible. Range: 10 MHz ±10 kHz. Input Impedance: 10 kΩ ±5%. Max. Input Voltage: 0 V to +5 V.

OPERATING MODES

Continuous – Generates the waveform continuously.

Triggered Continuous – Output quiescent until triggered by an external, GPIB, or manual trigger; then generates a sequence after pre-defined delay and stops by STOP command or GPIB command.

Gated – Same as triggered mode except period is executed after the pre-defined delay for the duration of the gated signal. The last sequence started is completed.

Time Burst – Output quiescent until triggered by an external, GPIB, or manual trigger; then generates "n" sequences or cycles.

TRIGGER

Trigger Delay – 5 digits, 0.7 µs to 100 sec. Accuracy: Synthesizer On, ±(0.1 µs + 0.01%); Synthesizer Off, ±(0.2 µs + 0.01%).

Time – 3 digits, 0.4 µs to 100 sec. Accuracy: ±0.1 µs.

PROGRAMMABLE INTERFACE

GPIB – IEEE-488.2-1987 compatible.

RS-232C – 25-pin D connector.

General Characteristics (applies to both the AWG 2020 and AFG 2020)

ENVIRONMENTAL

Temperature – Operating: +10°C to +40°C. Non-operating: –20°C to +45°C.

Temperature Change – Operating: ≤15°C per hour (no condensation). Non-operating: ≤30°C per hour (no condensation).

Humidity – Up to 80% RH.

Altitude – Operating: 4.6 km (15,000 ft.). Non-operating: 15 km (50,000 ft.).

Vibration – 0.003 in. p-p, 5 Hz to 55 Hz (0.5g at 55 Hz).

Shock – 20 g (1/2 sine) 11 ms duration.

EMC – Within limits of FCC Regulations, Part 15, Subpart J, Class A; VDE 0871/6.78, Class B.

Electrical Discharge – Operating max test voltage: 15 kV (150 pF through 150 Ω).

Safety – Designed to meet UL 1244 and CSA 22.2 No. 231.

POWER

Source Power – Voltage Ranges: Selectable from 90-127 VAC or 180-250 VAC with internal jumper. Line Frequency: 48-63 Hz.

Power Dissipation – 300 W.

Maximum Current – 5 amps.

PHYSICAL

Dimensions	mm	in.
Height	164	6.4
Width (with handle)	362	14.25
Length	491	19.25
Weight	**kg**	**lbs.**
Net	9.0	19.8

OTHER

Display – 7 in. diagonal, electro-magnetic deflection CRT.

Recommended Adjustment Interval – 1000 hours or 6 months, whichever occurs first.

ORDERING INFORMATION

AWG 2020

Programmable Arbitrary Waveform Generator **$11,995**
Includes: User Manual, Programmers Manual, Waveform Data Format Conversion Software, Sample Waveform Library Disk, Power Cable.

Opt. 02 – Add Second Channel ..... **+$4,250**
Opt. 03 – 12-bit Digital Out ..... **+$705**
Opt. 09 – Digital Signal Processing ..... **+$1,070**
Opt. 1R – Rackmount ..... **+$655**
Opt. 1B – Service Manual *1

AFG 2020

Programmable Arbitrary Function Generator **$7,995**
Includes: User Manual, Programmers Manual.

Opt. 02 – Add Second Channel ..... **+$2,950**
Opt. 1R – Rackmount. ..... **+$550**
Opt. 1B – Service Manual *1

ADDITIONAL ACCESSORIES

Rackmount Kit – Order 016-1166-00 ..... **$350**
Accessory Pouch – Order 016-1159-00 ..... **$60**
Front Cover – Order 200-3232-00 ..... **$11.75**
Differential Amplifier – Order AM502 ..... **$1,795**
Programmable Multiplexer – Order SI5010 ..... **$2,750**

RECOMMENDED OSCILLOSCOPES

Tektronix TDS Series, 2400 Series, or 2200 Series Digital Storage Oscilloscopes.

TEST SOFTWARE

The following optional IBM compatible test software is available for use with the AWG 2020 and AFG 2020:

WaveWriter/AWG – Order S3FT400 ..... **$795**
TEKTMS/IPG – Order S3FT100 ..... **$595**
EZ-TEST PC – Order S45F030 ..... **$595**

INTERNATIONAL POWER PLUG OPTIONS

Opt. A1 – Universal Euro 220 V, 50 Hz ..... **NC**
Opt. A2 – United Kingdom 240 V, 50 Hz ..... **NC**
Opt. A3 – Australian 240 V, 50 Hz ..... **NC**
Opt. A4 – North American 240 V, 60 Hz ..... **NC**
Opt. A5 – Switzerland 220 V, 50 Hz ..... **NC**

**1 Contact your local Tektronix representative for price information.*

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

GPIB IEEE-488 — The AFG 2020 and AWG 2020 complies with IEEE Standard 488.1-1987, and with Tektronix Standard Codes and Formats.

AWG 5105

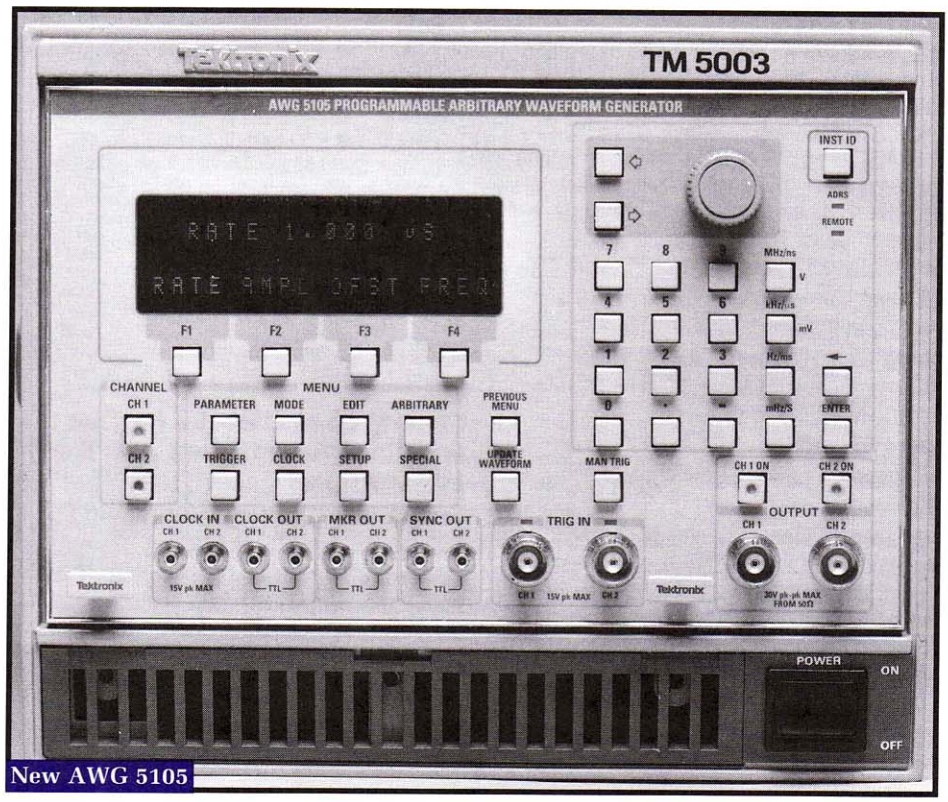
Arbitrary Generator

Signal Sources

Our highest performance plug-in module with optional second channel.

AWG 5105

- Fully Programmable from Front Panel or GPIB
- Arbitrary Waveform Generation from 1 µHz to 25 MHz
- 64K per Channel Executable Memory
- Non-Volatile Storage for up to 98 Front Panel Settings
- 15 mV to 15 Vp-p into 50 Ω
- Simulated Analog Functions from 0.001 Hz to 3 MHz
- Convenient Creation and Modification of Waveforms with WaveWriter™ Software
- Ext Clock In/Out



New AWG 5105

New AWG 5105

The Tektronix GPIB compatible AWG 5105 Arbitrary Waveform Generator lets you accurately simulate complex waveform events by combining standard synthesized function generator capabilities with arbitrary waveform generation. The AWG 5105 can output predefined sine, square, triangle, ramp up, ramp down, white noise, and DC levels. Frequency capabilities range from 0.001 Hz up to 25 MHz with amplitudes from 15 mV to 15 V peak-to-peak into 50 Ω. These waveforms can be continuous, triggered, gated, or burst. Triggering can be selected from an internal, external, manual, or GPIB trigger. You can also apply amplitude modulation as well as external summing.

FLEXIBILITY TO GENERATE A WIDE VARIETY OF COMPLEX WAVEFORMS

The 64K addresses on the horizontal axis and 4096 possible levels for each address (12 bit vertical axis) gives you an array of over 268 million points to define virtually any waveshape that can be mathematically generated, transferred from computer graphics, or captured by a waveform digitizer or digital scope.

Waveforms can be defined point-by-point or you can place one of the pre-defined waveforms – sine, square, triangle, ramp up, ramp down, plus white noise – into memory and then edit it for the desired output.

DYNAMIC MARKERS USEABLE AS POINT COINCIDENTAL DELAYED TRIGGER OUTPUT

When used with a sweep source or an arbitrary waveform, a marker can be dynamically positioned to indicate frequency and provide instant readout of breakpoints, notches, or response anomalies. The marker can be used to create an intensified region on the oscilloscope display.

EASILY DRAW YOUR OWN WAVESHAPES WITH AUTOLINE

Tektronix' Autoline feature makes waveform editing and generation a snap. Simply define the amplitudes of two addresses in the arbitrary waveform memory, then press the "Autoline" button. The data values for each consecutive address to produce a straight line between the end points is automatically computed.

NON-VOLATILE MEMORY TO SAVE YOUR WAVEFORMS

Non-volatile memory allows storage of arbitrary waveforms and up to 98 different stored front-panel settings. This allows you to recall extensive sets of waveforms for test or calibration sequences. Since the waveforms are generated from memory, they are accurate and reliable.

CONFIGURATIONS

The AWG 5105 is a three-wide plug-in module that fits into the Tektronix TM 5003 and TM 5006 power module mainframes (GPIB interface option required).

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

GPIB IEEE-488 — The AWG 5105 complies with IEEE Standard 488.1/488.2-1987, and with Tektronix Standard Codes and Formats.

Arbitrary Generator
Signal Sources

TYPICAL APPLICATIONS
Following are only a few of the many applications possible with these versatile instruments:

- **Biomedical applications –** use arbitrary waveforms to test sensitive measuring equipment. You can simulate heartbeats, nerve responses, EEG brainwave patterns, and many other stimulus signals.
- **Materials testing –** use arbitrary waveforms to simulate metal stress and fatigue test conditions.
- **R&D applications –** simulate waveforms from sensors, timers, and other lab equipment for design and development.
- **Electronics design and test –** arbitrary waveforms can simulate synchronization and servo-mechanism drive waveforms.
- **Mechanical and electronic engineering –** develop a library of waveforms to simulate vibration characteristics.
- **Automotive design –** use arbitrary waveforms to simulate electrical signals to test components.

AWG 5105 Characteristics

WAVESHAPES
Sine, square, triangle, ramp up, ramp down, arbitrary, white noise, and DC (available in Edit Menu).

OPERATING MODES
Continuous – Output continuous at programmed waveshape, frequency, amplitude, and offset.

Triggered – Output quiescent until triggered by an internal, external, GPIB, or manual trigger; then generates one cycle.

Gated – Same as triggered mode except waveform is executed for the duration of the gated signal. The last cycle started is completed.

Burst – Same as triggered mode for programmed number of cycles from 2 to 999,999; 2 is the default value.

Amplitude Modulation – The generator can be externally modulated.

FREQUENCY CHARACTERISTICS
Range – <1 μHz (64K points) to 25 MHz (2 points).

Resolution – 4 digits (9,999 counts).

Accuracy – 0.02% of reading in continuous mode. ±3% of reading in triggered, gated, and burst modes.

Jitter – <0.1% RMS.

Stability – ±0.2% in continuous mode for all time intervals. ±0.5% for 24 hours in other modes.

Repeatability – ±1% for 24 hours in other than continuous mode.

MAIN OUTPUT
Amplitude Range – 15 mV to 15 Vp-p into 50 Ω (30 mV to 30 Vp-p into open circuit). Open circuit values are two times the displayed values.

Amplitude Resolution – 3.5 digits, 10 mV from 1.5 V to 15 Vp-p into 50 Ω; 1 mV from 15 mV to 1.499 Vp-p into 50 Ω.

Amplitude Accuracy – ±2.0% of setting ±20 mV of programmed value for 1.5 to 15 V. ±3% of setting ±5 mV for 15 mV to 1.5 V output. Specified for synthesized waveform output at 1 kHz.

Repeatability – ±1% for 24 hours.

Output Impedance – 50 Ω.

Output Protection – The instrument is non-destructively protected against short circuits or accidental voltage of up to ±100 V (DC plus peak AC) applied to the main output connector.

OUTPUT OFFSET
Offset Range – –7.5 V to +7.5 V into 50 Ω (–15 V to +15 V into open circuit).

Resolution – 3 digits (750 counts).

Accuracy – ±(0.5% of setting) ±50 mV.

Repeatability – ±1% for 24 hours. Ripple and Noise: <10 mVp-p.

Offset Plus Peak Amplitude – Absolute peak amplitude plus offset is limited to 7.50 V maximum into 50 Ω.

$$|\text{Offset setting}| + \frac{\text{amplitude setting}}{2}$$

must be ≤7.50 V.

AUXILIARY OUTPUTS
Clock Output **– TTL level squarewave at point execution rate. Output Impedance: 50 Ω.

Sync Output **– Positive TTL level pulse (programmable). Output Impedance: 50 Ω.

Marker Out –** Positive TTL level pulse, duration of one clock rate. Output when the selected memory point is executed. Up to four different points may be programmed. Output Impedance: 50 Ω.

AUXILIARY INPUTS
Clock Input* – TTL compatible. Bandwidth: 50 MHz max. Input Impedance: 10 kΩ. Max Input Voltage: 15 VDC + peak AC.

Triggering/Gating In*– Positive selects positive triggering and positive-true gating, negative selects negative slope triggering and negative-true gating. Sensitivity: 250 mVp-p min. Resolution: ±9.99 V range, 3 digits (10 mV). Accuracy: ±5% of setting ±25 mV. Bandwidth: DC to 15 MHz with 25 ns, 150 mV min pulse. Input Impedance: 10 kΩ. Max Input Voltage: 15 VDC + peak AC.

Adjustable External Trigger In – Time Delay: 1 μs to 999.9 sec range. Resolution: Up to 4 digits (limited to 1 μs). Accuracy: ±0.01% accuracy.

AM Input–** Level: 5 Vp-p for 100% modulation. Bandwidth: DC to 20 kHz. Input Impedance: 10 kΩ. Max Input Voltage: 15 VDC + peak AC.

Arbitrary Hold Input **– TTL compatible HI holds arbitrary execution. Input Impedance: 10 kΩ. Max Input Voltage: 15 VDC + peak AC.

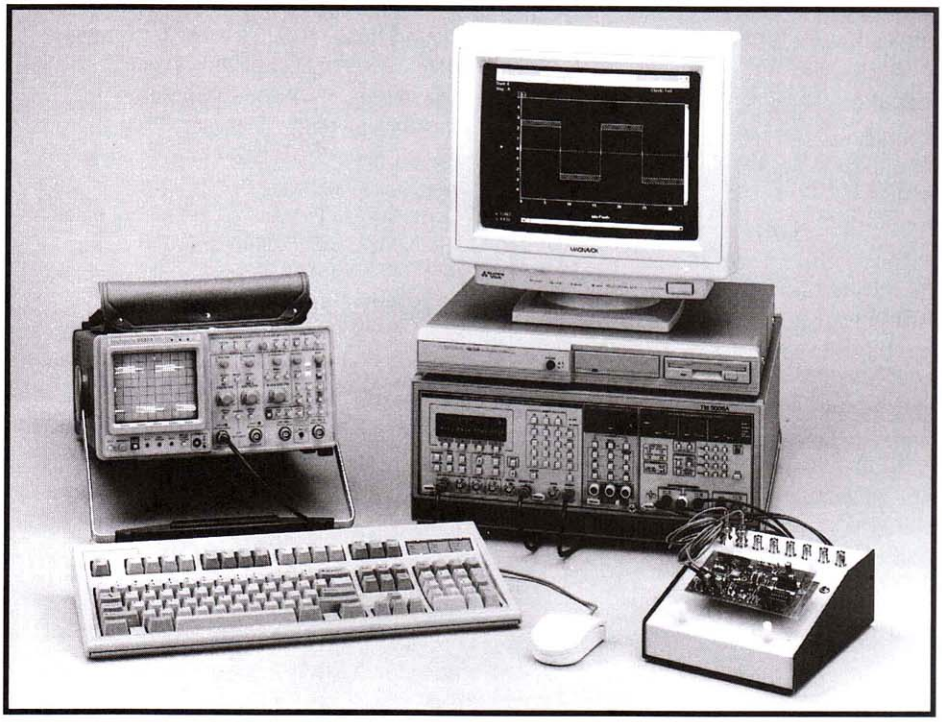
External Summing Input–** Level: 1 V for full-scale output. Bandwidth: 10 MHz. Input Impedance: 1 kΩ.

**Also available at rear interface.*
***Available only at rear interface.*

AWG 5105

Arbitrary Generator

Signal Sources



Complex waveform capture and simulation packages are easily configured with Tektronix Arbitrary Generators.

ARBITRARY WAVEFORMS

Horizontal Resolution – 64K (65,536 points) execution memory per channel. 256K (262,144 points) non-volatile waveform storage memory.

Vertical Resolution – 12 bits (4095 points).

Output Amplitude – 15 mV to 15.0 Vp-p into 50 Ω (30 mV to 30 Vp-p open circuit).

Output Accuracy – 1.5 V to 15 V, ±(2.0% of setting) ±20 mV. 15 mV to 1.5 V ±(3.0% of setting) ±5 mV.

Point Duration – 20 ns to 150 sec with 4 digits resolution. Accuracy better than 0.02%. Limited to 0.01 ns resolution.

Risetime/Falltime – –2047 to +2047 data change at maximum amplitude (15 Vp-p) into 50 Ω. ≤15 ns (10% to 90%) at maximum amplitude.

Filters – 4 selectable, single-pole filters. Filter 3 dB cutoff frequency:

0 – Filter off.
1 – Typically 1.5 MHz ±20%.
2 – Typically 150 kHz ±20%.
3 – Typically 15 kHz ±20%.
4 – Typically 1.5 kHz ±20%.

INTERNAL TRIGGER

Repetition Rate Range – 1 µs to 999.9 sec.

Resolution – 4 digits, 1 µs maximum.

Accuracy – ±0.01%.

GPIB PROGRAMMING

Interface – IEEE-488.2, 1987 and SCPI compatible.

ENVIRONMENTAL

Temperature – Operating: 0°C to +50°C. Non-operating: –20°C to +60°C.

Humidity – 95% RH, 0°C to 30°C. 75% RH, to 40°C. 45% RH, to 50°C.

Altitude – Operating: 4.6 km (15,000 ft.). Non-operating: 15 km (50,000 ft.).

Vibration – 0.38 mm (0.015 in.) p-p, 5 Hz to 55 Hz for 75 minutes.

Shock – 30 g's (1/2 sine) 11 ms duration.

EMC – Within limits of FCC Regulations, Part 15, Subpart J, Class A; VDE 0871, Category B; MIL-461B (1980) for RE01, RE02, CE01, CE03, RS01, RS03, CS01, CS02, and CS06.

Electrical Discharge – Operating max test voltage: 15 kV (150 pF through 150 Ω). Non-operating max test voltage: 20 kV (150pF through 150 Ω).

Safety – Designed to meet UL 1244 and CSA 22.2 No. 231.

POWER

Power Consumption – 50 VA maximum, limited by internal fuse.

Power Dissipation – 110 W.

PHYSICAL

Dimensions	cm	in.
Height	12.7	5.0
Width	20.32	8.0
Length	27.94	11.0
Weight	**kg**	**lbs.**
Net	1.8	4.0

OTHER

Memory – 256K (262,144 point) non-volatile waveform memory (shared with second channel for Opt. 02). 64K (65,536) point volatile waveform execution buffer per channel.

Display – Two line alphanumeric, 16 character LED. Provides clear descriptive error messages.

Recommended Adjustment Interval – 1000 hours or 6 months, whichever occurs first.

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

GPIB IEEE-488 — The AWG 5105 complies with IEEE Standard 488.1-1987, and with Tektronix Standard Codes and Formats.

ORDERING INFORMATION

AWG 5105

Programmable Arbitrary/Function Generator **$5,995**

Includes: Instrument Manual; Reference Guide; Instrument Interfacing Guide.

Opt. 02 – Add 2nd Channel ..... **+$2,000**

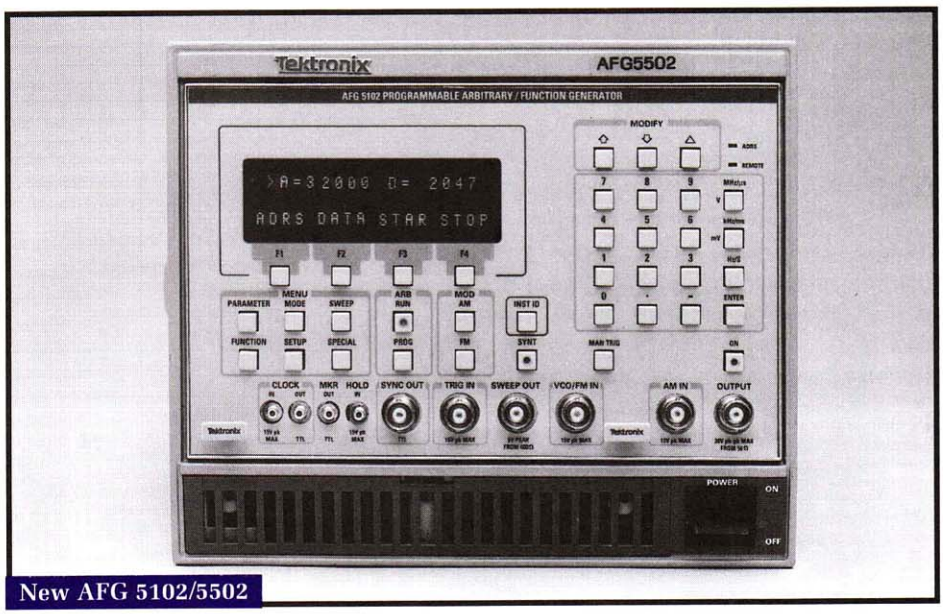
SOFTWARE

See Software Section for complete description.

Wavewriter – Order S3FT400 ..... **$795**

Arbitrary Generators
Signal Sources

AFG 5102 AWG 5102
AFG 5502 AWG 5502



New AFG 5102/5502

Four New Arbitrary Generators

The Tektronix GPIB compatible AWG 5102/5502 Arbitrary Waveform Generators let you accurately simulate complex waveform events by combining standard synthesized function generator capabilities with arbitrary waveform generation. The AFG 5102/5502 Arbitrary Function Generators provide the same arbitrary capabilities with an accurate analog function generator. The AWG 5102/5502 and AFG 5102/5502 can output sine, square, triangle, ramp up, ramp down, and DC levels. Frequency capabilities range from 0.001 Hz (0.02 Hz for AWG 5102/5502) to 20 MHz with amplitudes from 15 mV to 15 V peak-to-peak into 50 Ω. These waveforms can be continuous, triggered, gated, or burst. Triggering can be selected from an internal, external, manual, or GPIB trigger. You can also apply amplitude or frequency modulation.

32K addresses on the horizontal axis and 4096 possible levels for each address (12 bit vertical axis) gives you an array of over 134 million points to define virtually any waveshape that can be mathematically generated, transferred from computer graphics, or captured by a waveform digitizer or digital scope. Waveforms can be defined point-by-point or you can place one of the pre-defined waveforms – sine, square, triangle, ramp up, ramp down – into memory and then edit it for the desired output.

Non-volatile memory is provided for storing arbitrary waveforms and automate up to 98 different stored front-panel settings. This allows you to recall extensive sets of waveforms for test or calibration sequences. Since the waveforms are generated from memory, they are accurate and reliable.

CONFIGURATIONS

The AWG 5102 and AFG 5102 are 3-wide plug-in modules that fit into the Tektronix TM 5003 and TM 5006 power module mainframes (GPIB interface option required). The AWG 5502 and AFG 5502 are monolithic, stand-alone instruments that include a power housing with GPIB interface. (NOTE: The generator module can be removed from its power housing and plugged into a compatible TM 5000 system.)

Characteristics

The following characteristics apply to both the AWG 5102/5502 and AFG 5102/5502 except as noted otherwise.

WAVESHAPES

Sine, square, triangle, arbitrary, ramp up, ramp down, and DC.

OPERATING MODES

Continuous – Output continuous at programmed waveshape, frequency, amplitude, and offset.

Triggered – Output quiescent until triggered by an internal, external, GPIB, or manual trigger; then generates one cycle.

Gated – Same as triggered mode except waveform is executed for the duration of the gated signal.

NBurst – Same as triggered mode for programmed number of cycles from 1 to 9,999.

Modulated – The generator can be amplitude modulated.

Increment – Frequency, amplitude, offset, rate, and burst can be manually incremented/decremented by a selectable delta.

NEW AWG 5102/ AWG 5502

NEW AFG 5102/ AFG 5502

- Fully Programmable from Front Panel or GPIB
- Arbitrary Waveform Generation from .02 μHz to 20 MHz
- 32K Memory for Waveform Storage
- Non-Volatile Storage for up to 98 Front Panel Settings
- 15 mV to 15 Vp-p into 50 Ω
- .02% Accuracy (50 ppm with Synthesizer Option, AFG only)
- Sine, Square, Triangle, Ramp Up, Ramp Down, and DC
- Independent Analog Function Generator 0.001 Hz (0.02 Hz for AFG 5102/5502) to 20 MHz
- Linear, Logarithmic, and Arbitrary Sweep Capabilities (AFG only)
- Convenient Creation and Modification of Waveforms with WaveWriter™ Software
- External Clock

AWG 5102/5502 offers low cost and high performance arbitrary waveforms. AFG 5102/5502 combines the features of the AWG with standard analog and sweep generator.

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

GPIB IEEE-488

The AFG 5102, AWG 5501, and 5502 complies with IEEE Standard 488.1-1987, and with Tektronix Standard Codes and Formats.

AWG 5102 AFG 5102 AWG 5502 AFG 5502 Arbitrary Generators

Signal Sources

SYNTHESIZED WAVEFORMS

Functions – User defined, or synthesized sine, square, triangle, ramp up, and ramp down with 0.1% frequency accuracy. From 0.001 Hz to 999.9 kHz for synthesized waveforms.

Horizontal Resolution – 32,768 points for non-volatile waveform storage memory. Additional 32,768 point execution memory.

Vertical Resolution – 12 bits (4095 points).

Output Amplitude (AWG 5102/5502 only) – 10 mV to 9.99 Vp-p into 50 Ω.

Output Accuracy (AWG 5102/5502 only) – 1.0 V to 9.99 V, ±(2.0% of setting) ±20 mV. 10 mV to 999 mV ±(3.0% of setting) ±5 mV.

Point Duration – 50 ns to 99.99 sec with 4 digits resolution. Accuracy better than 0.02%. Limited to 1 ns resolution.

Risetime – <20 ns (10% to 90%) with no filtering.

Filters – 4 selectable, single-pole filters. Filter 3 dB cutoff frequency from 1 MHz to 900 Hz.

AUXILIARY OUTPUTS

Clock Output*– TTL level squarewave at point execution rate.

Sync Output – Positive TTL level pulse at the end of each arbitrary cycle. Output Impedance: 50 Ω.

Marker Out*– Positive TTL level pulse, duration of one clock rate.

** Also available at instrument rear interface.*

AUXILIARY INPUTS

Clock Input*– TTL compatible. Bandwidth: 20 MHz max. Width: 20 ns min.

Trigger In – TTL compatible. Maximum rate: 20 MHz. Minimum width: 20 ns.

Arbitrary Hold Input*– TTL compatible.

** Also available at instrument rear interface.*

USER DEFINED WAVEFORMS (AWG 5102/5502 only)

Frequency – Range: <1 μHz (32K points) to 10 MHz (2 points). Resolution:4 digits (9999 counts). Accuracy: 0.02% of reading in continuous mode; ±3% of reading in triggered, gated, and burst modes. Jitter: <0.1% RMS. Stability: ±0.2% in continuous mode for all time intervals; ±0.5% for 24 hours in other modes.

OUTPUT AMPLITUDE (AWG 5102/5502 only)

Amplitude Range – 10 mV to 9.99 Vp-p into 50 Ω.

Amplitude Resolution – 3 digits, 10 mV from 1 V to 9.99 Vp-p into 50 Ω; 1 mV from 10 mV to 0.999 Vp-p into 50 Ω.

Amplitude Accuracy – ±2.0% of setting ±20 mV of programmed value for 1.0 to 9.99 V. ±3% of setting ±5 mV for 10 mV to 999 mV output, specified for synthesized waveform output at 1 kHz.

OUTPUT OFFSET (AWG 5102/5502 only)

Offset Range – –4.99 V to +4.99 V into 50 Ω. Resolution: 3 digits when p-p amplitude is <999 mV; 10 mV when p-p amplitude is >1 V. Accuracy: ±(0.5% of setting) ±20 mV.

Offset Plus Peak Amplitude – Absolute peak amplitude plus offset is limited to 4.99 V maximum into 50 Ω.

$$|\text{Offset setting}| + \frac{\text{amplitude setting}}{2}$$

must be ≤5.0 V.

INTERNAL TRIGGER

Repetition Rate Range – 1 μs to 99.99 sec.

GPIB PROGRAMMING

Interface – IEEE-488.1, 1987 compatible.

Characteristics AFG 5102/AFG 5502

The following characteristics are unique to the AFG 5102/5502.

OPERATING MODES

Same as AWG 5102/5502 with the following additions:

Burst – Same as triggered mode for programmed number of cycles from 2 to 9,999.

Amplitude Modulation – The generator can be externally modulated.

Frequency Modulation – Standard waveforms can be frequency modulated by an external signal.

Variable Symmetry – Duty cycle of standard waveform adjustable from 10-90% up to 2 MHz.

FREQUENCY CHARACTERISTICS

Range – 0.02 Hz to 20 MHz.

Resolution – 3.5 digits (1,999 counts).

Accuracy – 0.2% of reading from 200 Hz to 20 MHz in continuous mode. ±5% of reading at all other ranges.

Jitter – <0.1% RMS.

Stability – ±0.2% in continuous mode for all time intervals. ±0.5% for 24 hours in other modes.

OUTPUT CHARACTERISTICS

Amplitude Range – 15 mV to 15.0 Vp-p into 50 Ω (30 mV to 30 Vp-p into open circuit).

Amplitude Resolution – 3.5 digits (1500 counts).

Amplitude Accuracy – ±2.0% ±20 mV of programmed value for 1.5 to 15 V output. ±3% ±5 mV for 15 mV to 1.5 V output. Specified for synthesized waveform output at 1 kHz.

Sinewave Distortion – <0.5 THD (RMS), 20 Hz to 100 kHz. 1.5 V to 15.0 V amplitude.

Arbitrary Generators
Signal Sources

AWG 5102 **AFG 5102**
AWG 5502 **AFG 5502**

Squarewave Symmetry – ≤±0.5%, 200 Hz to 199.9 kHz; ≤±1%, 0.02 to 1.999 MHz; ≤±5%, 2.0 MHz to 20 MHz (set at 50%).

Squarewave Risetime – <12 ns, 10% to 90% at full output amplitude.

Triangle Linearity – 98% to 100 kHz measured from 10% to 90% on waveform.

DC Mode – –7.49 V to +7.49 V into 50 Ω (–14.98 V to +14.98 V into open circuit).

OUTPUT OFFSET

Offset Range – –7.49 V to +7.49 V into 50 Ω (–14.98 V to +14.98 V into open circuit).

Offset Plus Peak Amplitude – Absolute peak amplitude plus offset is limited to 7.50 V maximum into 50 Ω.

$$|\text{Offset setting}| + \frac{\text{amplitude setting}}{2}$$

must be ≤7.5 V.

AUXILIARY OUTPUTS

Same as AWG 5102/5502 with the following additions:

Sweep Output – Same waveshape as selected sweep.

AUXILIARY INPUTS

Same as AWG 5102/5502 with the following additions:

VCO/FM Input – Level: 0 to +5 V for a 1000:1 frequency change. Bandwidth: DC to 20 kHz.

ARBITRARY WAVEFORMS

Same as AWG 5102/5502 with the following exceptions:

Output Amplitude – 15 mV to 15.0 Vp-p into 50 Ω.

Output Accuracy – 1.5 V to 15 V, ±(2.0% of setting) ±20 mV. 15 mV to 1.5 V ±(3.0% of setting) ±5 mV.

Risetime/Falltime – –2047 to +2047 data change at maximum amplitude (9.99 Vp-p) into 50 Ω. ≤20 ns (10% to 90%) at 9.99 V amplitude.

FREQUENCY SWEEP

Sweep Types – Linear, logarithmic, and arbitrary.

Sweep Time – 50 ns to 99.99 sec per point. 1ns (4 digits) maximum resolution. For linear and logarithmic sweeps, one sweep equals 1000 points for the time base. Arbitrary sweeps may be defined with up to 32,767 horizontal points for the time base.

Sweep Width – 1000:1 maximum. Start frequency and stop frequency must be in the same range.

Sweep Ranges – 20 kHz to 20.0 MHz, 2 kHz to 2.0 MHz, 200 Hz to 200.0 kHz, 20 Hz to 20 kHz, 2 Hz to 2 kHz, 0.2 Hz to 200 Hz, 0.02 Hz to 20 Hz.

SYNTHESIZER CHARACTERISTICS

Resolution – 5 digits (20,000 counts max). Range: 2.01 Hz to 20 MHz.

Accuracy – ±0.005%. Stability: 10 ppm per °C.

Frequency Locking Time – <2 sec + 100 cycles.

General Characteristics (applies to both the AWG 5102/5502 and AFG 5102/5502)

ENVIRONMENTAL

Temperature – Operating: 0°C to +50°C. Non-operating: –20°C to +60°C.

Humidity – 95% RH, 0°C to 30°C. 75% RH, to 40°C. 45% RH, to 50°C.

Altitude – Operating: 4.6 km (15,000 ft.); Non-operating: 15 km (50,000 ft.).

Vibration – 0.38 mm (0.015 in.) p-p, 5 Hz to 55 Hz for 75 minutes.

Shock – 30 g's (1/2 sine) 11 ms duration.

EMC – Within limits of FCC Regulations, Part 15, Subpart J, Class A; VDE 0871, Category B; MIL-461B (1980) for RE01, RE02, CE01, CE03, RS01, RS03, CS01, CS02, and CS06.

Electrical Discharge – Operating max test voltage: 15 kV, 150 pF through 150 Ω. Non-operating max test voltage: 20 kV (150 pF through 150 Ω).

Safety – Designed to meet UL 1244 and CSA 22.2 No. 231.

POWER

Source Power (AWG 5502, AFG 5502) – Voltage Ranges: Selectable from 100 V, 120V, 220 V, 240 V nominal ±10%(not to exceed 250 V). Line Frequency: 50-60 Hz.

Power Consumption – 50 VA maximum, limited by internal fuse.

Power Dissipation – AWG 5102, AFG 5102: 60 W. AWG 5502, AFG 5502: 90W.

PHYSICAL

AWG 5102, AFG 5102

Dimensions	mm	in.
Height	12.7	5.0
Width	20.32	8.0
Length	27.94	11.0
Weight	**kg**	**lbs.**
Net	1.8	4.0

AWG 5502, AFG 5502

Dimensions	mm	in.
Height	14.0	5.5
Width	23.4	9.2
Length	43.2	17.0
Weight	**kg**	**lbs.**
Net	5.3	14.3

OTHER

Memory – Non-volatile, stores up to 98 front-panel settings. 32,768 bit arbitrary waveform memory.

Display – Two line alphanumeric, 16 character LED. Provides clear descriptive error messages.

Recommended Adjustment Interval – 1000 hours or 6 months, whichever occurs first.

ORDERING INFORMATION

AFG 5102
Programmable Arbitrary/ Function Generator **$3,995**
Includes: Instruction Manual.

AFG 5502
Programmable Arbitrary/ Function Generator **$4,795**
Includes: Instruction Manual.

AWG 5102
Programmable Arbitrary/ Waveform Generator **$2,995**
Includes: Instruction Manual.

AWG 5502
Programmable Arbitrary/ Waveform Generator **$3,795**
Includes: Instruction Manual.

SOFTWARE
See software section for a complete description.
WaveWriter – Order S3FT400 ..... **$795**

SERVICE MANUALS
AFG 5102 ..... *1
AFG 5502 ..... *1
AWG 5102 ..... *1
AWG 5502 ..... *1

*[1] *Please contact your local Tektronix representative for price and ordering information.*

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

GPIB IEEE-488 — The PFG 5105 and PFG 5505 comply with IEEE Standard 488.1-1987, and with Tektronix Standard Codes and Formats.

Function Generators

Signal Sources

CONTENTS

FUNCTION GENERATORS

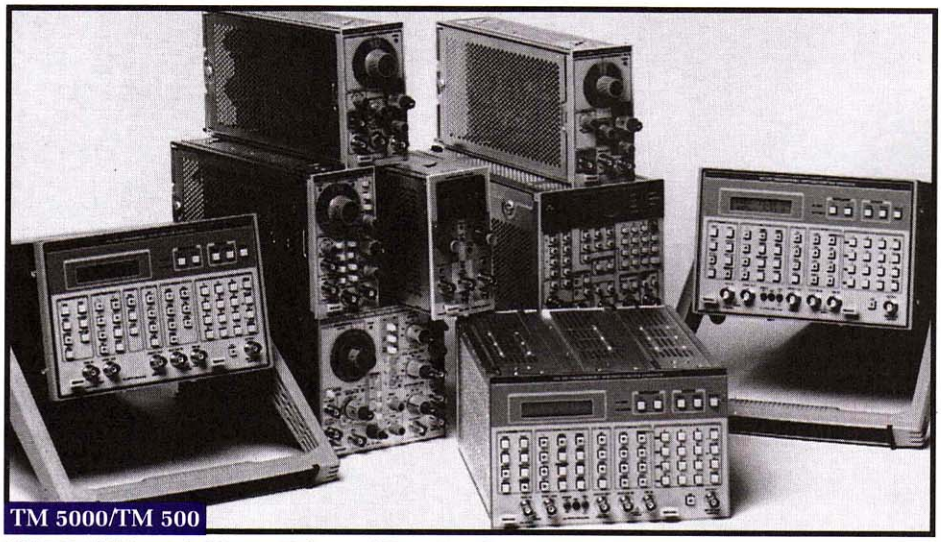
General Information....298
PFG 5105....300
PFG 5505....300
FG 5010....302
FG 504....302
FG 503....304
FG 502....304
FG 501A....304

Function Generators

Function generators stimulate devices and circuits under test by simulating typical waveforms. Stimulation can be applied to circuits ranging from a single logic device to a satellite communications system or a heart pacemaker. Waveforms simulated can range from a simple train of pulses to representations of spread-spectrum modulated RF signals or cardiac systole. All of them offer sine, triangle, and square-wave outputs. Many provide ramp and pulse outputs, obtained by varying the symmetry of triangle and square waves. That is, variable symmetry lets you take a triangle wave and increase the slew rate of its leading edge while decreasing the slew rate of its trailing edge, simulating the sweep functions used in raster-scan display devices. Varying the symmetry of square waves lets you emulate a pulse generator by giving you precise control over pulse width and duty cycle. The need for sines, ramps and pulses is easy to understand, but when do you need triangle and square waves? Triangle waves are used to characterize or verify tracking, detection, switching or trip points. They help determine the switching thresholds of comparators, Schmitt triggers, peak detectors, A-to-D converters, and hysteresis circuits. Square waves help characterize the switching response of amplifiers, gates, and level translators. They make it possible to measure risetime, slew rate, overshoot, overdrive recovery and settling time.

Frequency accuracy is three to five percent on instruments with mechanical-dial frequency input, and typically better than 0.1 percent on instruments with digital controls. This can be enhanced to better than 0.005 percent accuracy with a synthesizer mode, in which the function generator is locked to a reference crystal oscillator. On instruments such as the FG 5010, it is possible to lock the phase of the output to a reference signal while varying relative phase plus and minus 90 degrees. Except in more expensive instruments, square-wave/pulse risetimes are slower than those output by pulse generators. Typical values are 20 to 25 ns, although the Tektronix FG 504 offers 6 ns risetimes.

All function generator outputs can be triggered and gated. In triggered mode, you get one cycle of output each time a trigger signal is applied. Some function generators also provide burst mode, in which a preset number of cycles is output for each trigger. In gated mode, you get output as long as the trigger signal is asserted. The frequency of sinewave outputs can be swept, with the sweep signal available for driving the horizontal section of an oscilloscope. Generally, swept measurements are used in aligning receivers and in evaluating amplifier and filter response. In addition, frequency sweeps also simulate the "chirp" waveforms found in radar and other speed and distance measuring systems.



TM 5000/TM 500 Arbitrary, Pulse and Function Generators.

Function Generators

Signal Sources

FUNCTION GENERATOR SELECTION GUIDE

	FG 501A	FG 502	FG 503	FG 504	FG 5010	PFG 5105/5505
Sine, Square, Triangle Waveforms	•	•	•	•	•	• +DC
Pulse	•	•		•	•	•
Ramp	•	•		•	•	
Frequency Range (Hz)	0.002 to 2 M	0.1 to 11 M	1 to 3 M	0.001 to 40 M	0.002 to 20 M	0.012 12 M
Amplitude (Vp-p) open circuit into 50 Ω	30 15	10 5	20 10	30 15	20 10	19.98 9.99
Offset (VDC) open circuit into 50 Ω	±13 ±6.5	±5 ±2.5	±7.5 ±3.75	±7.5 ±3.75	±7.5 ±3.75	±9.98 ±4.99
Peak Signal + Offset (VDC) open circuit Into 50 Ω	±15 ±7.5	±10 ±5	±15 ±6	±20 ±11.25	±15 ±7.5	±9.98 ±4.99
Sine Wave Amplitude Flatness (Hz) (10 kHz ref, 50-Ω load)	±0.1 dB, 20 to 20K; ±0.5 dB, 20K to 1 M; ±1 dB, 1 M to 2 M	±0.5 dB, 20 to 20K; ±1.5 dB, 0.1 to 11 M	±0.5 dB, 20 to 20K; ±2 dB 0.1 to 3 M	±0.5 dB, 0.001 to 40K ±2 dB to 40 M	±3%, 0.002 to 1K; +3.5%, 1K to 1 M; ±5%, 1 to 5 M; +5% –10%, 5 to 20 M	0.5 dB, 0.012-120K 2.0 dB to 1.2 M, ±3 dB to 12 M 1 kHz ref
Sine-Wave Distortion (Hz, Maximum Output, 50-load)	≤0.25%, 20 to 20K	≤0.5%, 10 to 50K	≤0.5%, 1 to 30K;	≤0.5%, 20 to 40K	±0.5%, 20 to 19.99K	<0.6%, 21 Hz to 120K
Triangle Linearity (Hz 10 to 90%)	≥99%, 20 to 200K ≥97%, 200K to 2 M	≥99%, 0.1 to 100K; ≥97%, 100K to 1 M; ≥95%, 1 to 11 M	≥99%, 1 to 100K; ≥95%, 100K to 3 M	≥99%, 10 to 400K; ≥95%, 400K to 40 M; ≥98%, 0.001 to 10 (typ.)	>98% to 2 M; >90% to 20 M	
Trigger Output (Vpeak)	≥+2 from 50 Ω	+2.5 to 50 Ω load	+2.5 to 600 Ω load	+2 from 50 Ω	+2 from 50 Ω	
External Output	Impedance ≈2 kΩ; Trigger threshold level +1 V ±20%	Impedance ≈1 kΩ; ≥+2 V gate signal required	No	Impedance ≥10 kΩ; Sensitivity ≤1 Vp-p; trigger level –1 to +10 V	1 MΩ/50 Ω selectable; 0.0 V/0.5 V selectable	
Trigger	±90° variable start phase control	No	No	20 MHz max., ±80° start phase control to 10 MHz	±90° variable start phase control	
Gate	±90° variable start phase control	Fixed 0°	No	No		
Phase Lock (Hz)		No		100 to 40 M ±80° phase range	20 to 20 M (Auto Scan)	
Counted Burst				No	1 to 9999	
Internal Sweep Duration		No		Log or linear, separate start/stop dials 0.1 M to 100	No	
Voltage Controlled Frequency (FM)	Up to 1000:1 frequency change with 10 V external signal					
Output Hold Mode (Hz)		No		0.001 to 400	0.002 to 200	
Symmetry (%)	≤5 to ≥95 variable	5, 50, 95 Fixed	50 Fixed	7 to 93 variable	10 to 90 1% steps	
Triangle	±0.5 dB, 20 to 200K; ±2 dB, 200K to 2 M	±3 dB ref to Sine Wave	±1 dB ref to Sine Wave	±2 dB, 40K to 40 M	±2%, 0.002 to 1K; ±3.5%, 1 to 100K; +4%, –5%, 1 to 5 M; +4%, –20% 5 to 20 M	
Square	±0.5 dB, 20 to 2 M	±3 dB ref to Sine Wave	±1 dB ref to Sine Wave	±0.5 dB to 20 M; ±2 dB to 40 M	±2%, 0.002 to 1K; ±3.5%, 1 to 100K; +4%, –5%, 1 to 5 M; +4%, –20%, 5 to 20 M	
Square-Wave Response	≤25 ns rise/fall <3% p-p aberrations	≤20 ns rise/fall ≤3% p-p aberrations	≤60 ns rise/fall ≤3% p-p aberrations	≤6 ns rise/fall fixed, 10 ns to 100 ms variable; ≤5% p-p +30 mV aberrations	≤10 ns rise/fall ≤5% p-p aberrations	
Modulation	FM	FM	FM	AM/FM	AM/FM	AM/FM
IEEE STD 488.1 1987					Yes	Yes
Modules Size	1 wide	1 wide	1 wide	2 wide	2 wide	3 wide

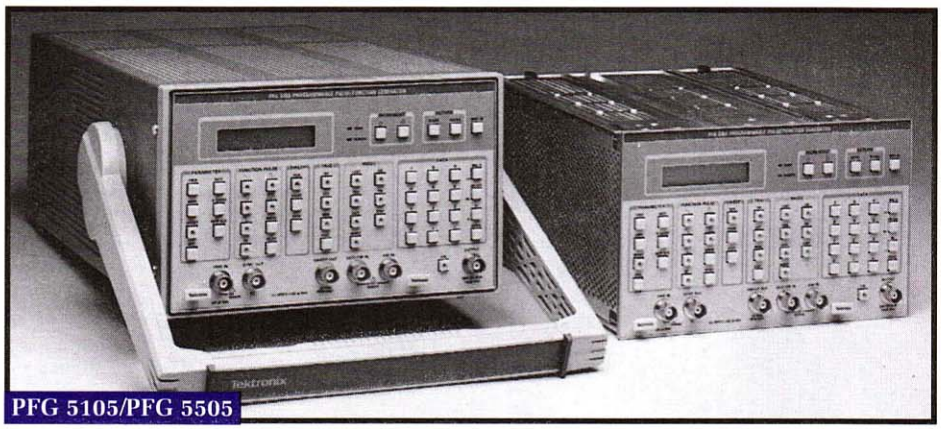
Function Generators

Signal Sources

Combine the advantages of pulse generation with the versatility of full-featured function generation and complete programmability

PFG 5105/PFG 5505

- 0.012 Hz to 12 MHz; Accuracies to 0.005% with Synthesizer Option
- Programmable Width and Delay
- 10 mV to 9.99 Vp-p Into 50 Ohms
- Continuous, Triggered, Gated and Burst, AM, VCF and Linear Sweep Modes
- Non-Volatile Storage for 99 Front Panel Settings



PFG 5105/PFG 5505

PFG 5105/PFG 5505

The PFG 5105/PFG 5505 Programmable Pulse/Function Generators combine the advantages of pulse generation with the versatility of full-featured function generation and complete programmability. Its waveform generation capabilities include pulse, double pulse, sine, triangle, square, and DC outputs from 0.012 Hz to 12 MHz in continuous, triggered, gated, burst, swept, and AM/VCF modes. A synthesizer option is available that locks the output to an internal quartz crystal for frequency accuracies of 0.005% (continuous mode only).

An additional internal-rate trigger clock is provided for allowing the creation of unique sequences of waveforms. This can be especially useful for creation of custom burst sequences.

In addition to complete programmability, the PFG 5105 has the ability to store up to 99 front panel settings which can be called up either from the front panel or through the GPIB. This feature reduces programming time and enhances standalone bench applications.

PAIRED PULSE GENERATION

Double pulse generation is very convenient when evaluating a circuit's ability to differentiate between two closely spaced pulses. Paired pulses can be generated at selected repetition rates with the delay control determining the time between the two pulses.

TM 5000 SERIES COMPATIBILITY

The PFG 5105/PFG 5505 is fully GPIB compatible and adheres to Tektronix Standard Codes and Formats, insuring ease of configurability and communication for integrated systems use configurations.

PFG 5105 occupies three slots in any TM 5000 Mainframe.

PFG 5505 is a standalone version of the PFG 5105.

OPTIONS

Opt. 02 adds a frequency lock synthesizer that provides a stable output waveform by locking the output to an internal quartz crystal. This option operates in continuous mode only, from 12.1 Hz to 12 MHz.

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

GPIB IEEE-488 — The PFG 5105 and PFG 5505 comply with IEEE Standard 488.1-1987, and with Tektronix Standard Codes and Formats.

Function Generators

Signal Sources

PFG 5105
PFG 5505

Characteristics

Waveforms – Sine, square, triangle, pulse, double pulse, and DC

OPERATING MODES
Continuous – Continuous, Triggered, Gated, Burst, Sweep, Modulation, and Increment.

FREQUENCY
Range – 0.012 Hz to 12.0 MHz.

Resolution – 3 1/2 digits (1200 counts); Optional synthesizer mode: 4 1/2 digits (1200 counts).

Accuracy – ±0.01% for pulse modes with internal triggering.

Continuos Mode – ±2% of reading (121 Hz to 1.2 MHz); ±5 of reading (1.2 MHz to 12 MHz); ±5% of reading (0.1 Hz to 120 Hz).

Jitter – <0.1% to 5MHz.

Stability – ±0.2% in continuous mode for all time intervals. (<±0.001%/degree C in optional synthesizer mode, 12.1 Hz to 12 MHz.) ±0.5% for 24 hours in other modes.

OUTPUT
Amplitude Range – 10 mV to 9.99 Vp-p into 50 Ω (20 mV to 19.98 Vp-p into open circuit).

Amplitude Resolution (into 50 Ω) –

Resolution	Range
10 mV	1 V - 9.99 Vp-p
1 mV	0.1 V - 0.999 Vp-p
1 mV	10 mV - 99 mVp-p

Amplitude Accuracy – ±2.0% ±20 mV of programmed value for 1.0 V to 9.99 V output at 20 to 30 degrees C; ±5% ±20 mV of programmed value for 1.0 V to 9.99 V output at 0 to 20 and 30 to 50 degrees C; ±5% ±5 mV for 10 mV to 999 mV output, specified for a sine, square, or triangle wave output at 1 KHz.

Repeatability – ±1% for 24 hours.

Amplitude Flatness – 0.5 dB from 0.0121 Hz to 120 KHz, ±2 dB to 1.2 MHz, ±3 dB to 12 MHz referenced to KHz sine, square or triangle wave.

Offset Range (into 50 Ω) –

Range	Source	(3 digit) Resolution
4.99 V	1 V - 9.99 V	10 mV
0.499 V	0.1 V - 0.999 V	1 mV
0.049 V	0.01 V - 0.099 V	1 mV

Repeatability – ±1% ±20 mV for 24 hours.

Output Impedance – 50 Ω.

Output Protection – The instrument is nondestructively protected against short circuits or accidental voltage of up to ±100 V (DC plus peak AC) applied to the main output connector.

WAVEFORM
Sine Distortion – <0.6% THD (RMS), 121 Hz to 120 KHz at 5 Vp-p amplitude at 20 to 30 deg. C. <1% THD (RMS), 12 Hz to 120 KHz over full temperature and amplitude range.

Squarewave Time Symmetry – <0.5%, 121 Hz to 120 KHz; ±1%, 121 Hz to 1.2 MHz; ±5%, 1.21 MHz to 12.0 MHz.

Pulse and Squarewave Transition Time – <15 ns 10 to 90% at full output amplitude; elsewhere <20 ns, 10 to 90%.

Pulse and Squarewave Aberrations – <8% of p-p amplitude ±20 mV from 3.4 to 9.99 Vp-p output amplitude. <10% of p-p amplitude below 3.34 Vp-p output amplitude.

Triangle Linearity – 98% to 100 KHz measured from 10% to 90% on waveform.

Pulse Width and Delay – 40 ns to 99.9 ms.

Resolution – 3 digits, 10 ns maximum.

Accuracy – ±5% of programmed value, ±10 ns.

Repeatability – ±1%, ±5 ns.

Pulse Duty Cycle – Delay plus width may be up to 85% of period.

Double (Paired) Pulse – 2 pulses of selected width up to 6 MHz separated by selected delay period.

INTERNAL TRIGGER ANALOG FUNCTIONS ONLY
Range – Repetition rate 100 ns to 999.9 s.

Resolution – 4 digits, 1 ns maximum.

FREQUENCY SWEEP
Sweep Type – Linear only.

Sweep Time – 100 ns to 999.9 s per point. 1 ns maximum resolution.

Sweep Width – 1200:1 maximum; start and stop frequencies must be in same range.

Sweep Ranges – 10 KHz to 12 MHz; 1 KHz to 1.2 MHz; 100 Hz to 120 KHz; and so on until 0.012 to 12 Hz.

SYNTHESIZER OPTION
Range – 12.1 Hz to 12 MHz.

Resolution – Frequency resolution (LSD of display) is 10 Hz on lowest range and 1 KHz on highest frequency range (4.5 digits or 12,000 counts).

Accuracy – ±50 ppm averaged measurement.

Stability – ±10 ppm/°C, or better.

Setting Time – Typically <2 s plus 100 cycles.

Jitter – ±0.1% from 12.1 Hz to 12 MHz.

GENERAL
Environmental – Operating: 0 to 50°C. Non-Operating: –55 to +75°C.

Power Consumption – 50 VA maximum limited by internal fuse.

Power Dissipation – PFG 5105: 30 W, PFG 5505: 90 W.

ORDERING INFORMATION

PFG 5105
Function Generator.....**$3,295**
Includes: Instrument Manual (070-7331-00); Reference Guide; Instrument Interface Guide (070-7329-00).

PFG 5505
Function Generator.....**$3,995**
Includes: Instrument Manual (070-7331-00); Reference Guide; Instrument Interface Guide (070-7329-00).

Opt. 02 – Adds a frequency lock synthesizer.....**+$350**

Service Manual – 070-7332-00.....**$55**

WARRANTY-PLUS SERVICE OPTIONS
Opt. M7 – Calibration Service
PFG 5105.....**+$235**
PFG 5505.....**+$200**

Opt. M9 – Repair Protection
PFG 5105.....**+$235**
PFG 5505.....**+245**

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

GPIB IEEE-488

The PFG 5105 and PFG 5505 comply with IEEE Standard 488.1-1987, and with Tektronix Standard Codes and Formats.

Function Generators

Signal Sources

Function Generators with superior features.

FG 5010

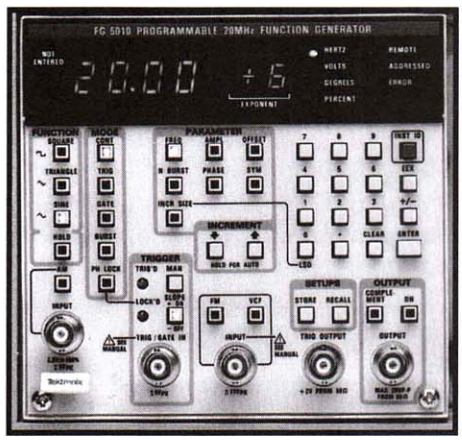
- 0.002 Hz to 20 MHz
- Up to 20 Vp-p From 50 Ω
- Sine, Square, Triangle, Pulse, and Ramp Waveforms
- 10 ns Rise/Fall
- 10 % to 90% Variable Symmetry in 1% Steps
- Trigger, Gate, Counted Burst
- Phase Lock, with Autoscan
- AM, FM, VCF
- Waveform Complement

FG 504

- 0.001 Hz to 40 MHz
- Three Basic Waveforms, Plus a Wide Range of Shaping with Variable Rise/Fall Times and Symmetry Controls
- Logarithmic or Linear Sweep
- Up to 30 Vp-p Output
- Built-In Attenuator
- AM and FM
- Phase-Lock Mode
- External and Manual Trigger or Gate

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

GPIB IEEE-488 — The FG 5010 complies with IEEE Standard 488.1-1987, and with Tektronix Standard Codes and Formats.



FG 5010 Programmable Function Generator

The FG 5010 Programmable Function Generator provides waveform generation from 0.002 Hz to 20 MHz. It provides not only the conventional sine, square, triangle, waveforms, but also incorporates variable symmetry which is usable throughout the frequency range and extends pulse and ramp capabilities beyond those of conventional generators. The FG 5010 also provides trigger, gate, counted burst, phase lock, AM, FM, and VCF modes. Variable phase enhances the trigger, gate, burst, and phase-lock modes.

All functions are fully programmable either from the front panel or over the GPIB. The ability to store up to 10 complete front panel settings reduces programming requirements and enhances standalone capability.

The FG 5010 maintains frequency accuracy within 0.1% over its full 0.002 Hz to 20 MHz frequency range. Automatic phase lock to an external signal is possible from 20 Hz to 20 MHz. Waveform complement and ± trigger slope allow interfacing to circuits with the proper waveform phase, especially important in pulse and digital applications. Waveform hold can freeze the output voltage of any 200 Hz or less waveform at its instantaneous value. With the output amplitude set to 0 V, the DC offset can be programmed to provide a DC voltage source of 0 to ±7.5 V in 10 mV steps.

Characteristics

Frequency Range – 0.002 Hz to 20 MHz.

Accuracy – Continuous mode, ±0.1%; Trigger, Gate, Burst Modes, Frequency ≤200 Hz, ±0.1%; frequency >200 Hz, ±5.0%.

Resolution – Continuous mode, 4 digits; Trigger, Gate, Burst modes, Frequency ≤200 Hz, 4 digits; Frequency >200 Hz, 3 digits.

Frequency Stability – ≤0.05% of full scale for 1 hour, ≤0.05% of full scale for 24 hours.

Amplitude – Range: 20 mV to 20 Vp-p into open circuit. 10 mV to 10 Vp-p into 50 Ω.

Triangle Amplitude Flatness – ±2%, 0.002 Hz to 1 kHz; ±3.5%, 1 kHz to 100 kHz; ±4%, 100 kHz to 1 MHz, +4%, −5%, 1 to 5 MHz; +4%, −20% 5 to 20 MHz.

Square Amplitude Flatness – ±2%, 0.002 Hz to 1 kHz; ±3.5%, 1 kHz to 1 MHz; ±5%, 1 to 10 MHz; ±10%, 10 to 20 MHz.

Sinewave Amplitude Flatness – ±3%, 0.002 Hz to 1 kHz; ±3.5%, 1 kHz to 1 MHz; ±5%, 1 to 5 MHz; +5%, −10%, 5 to 20 MHz.

Offset – Range: ±10 mV to ±7.5 V open circuit; ±5 mV to ±3.75 V into 50 Ω load. Maximum peak signal plus offset is ±15 V open circuit, ±7.5 V into 50 Ω load. Accuracy: ≤±(1% of the selected offset, +2% of the signal p-p amplitude, +20 mV). Resolution: 10 mV open circuit, 5 mV into 50 Ω load. 0 V is also provided.

Output Impedance – 50 Ω.

Sinewave Distortion – 20 Hz to 19.99 kHz, ≤0.5%; 20.0 kHz to 99.99 kHz, ≤1.0%; 100 kHz to 20.0 MHz, harmonics >30 dB down. Valid from +15°C to +35°C into 50 Ω load with 0 V offset, continuous mode, 50% symmetry, and AM, FM, VCF, and Complement off.

Square Wave Response – ≤10-ns rise/fall; ≤±(5% + 20 mV) aberrations.

Symmetry – 10 to 90%, 1% steps, ±2% accuracy. Range above 4 MHz is limited by 25 ns minimum triangle transition time (decreases to 50% at 20 MHz).

Triangle Linearity – >99% to 100 kHz; >98% to 2 MHz; >90% to 20 MHz.

Trigger Output – 0 ±100 mV to ≥2 V from 50 Ω into an open circuit.

TRIG, GATE, BURST, AND PH LOCK INPUT

Trigger Input – 1 M Ω/50 Ω selectable; 0.0 V/0.5 V selectable.

Amplitude Sensitivity – ≤250 mV p-p.

Maximum Input Amplitude – ±5 V peak into 50 Ω, ±20 V peak into 1 MΩ.

Burst Range – 1 to 9999 cycles.

Amplitude Modulation – 100% with 5 Vp-p, DC to ≥100 kHz, <2% distortion to 2 MHz at 70%, <4% to 20 MHz at 70%. Max. Amp. ±20 V.

Frequency Modulation – DC to ≥100 kHz, ≤2% distortion, Max. Amp. ±20 V.

VCF Modulation – 0 to 10 V produces >1000:1 Frequency change, DC to ≥100 kHz, ≥0.063 V/µs slew rate, Max. Amp. ±20 V.

Output Holdmode – 0.002 to 200 Hz

Phase Range – ±90° to 1 MHz, ±47° to 20 MHz. Resolution 1°.

Phase Lock Range – ±90° to 10 MHz, ±50° to 20 MHz. Resolution 1°.

GENERAL

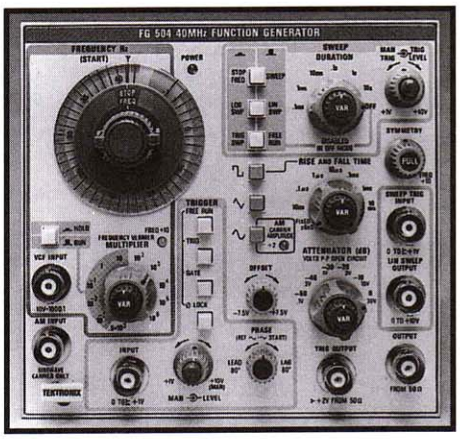
Environmental – Operating: 0 to 50°C. Non-operating: −55 to +75°C.

Power Consumption – 60 W.

Function Generators

Signal Sources

FG 5010
FG 504



FG 504 Function Generator

The FG 504 provides the three basic waveforms of sine, square and triangle plus a wide range of shaping with variable rise/fall times and symmetry controls. Pulses and ramps are easily generated.

The output of the FG 504 can be phase locked, gated, or triggered by a reference signal. This lets you convert from one waveform to another, such as pulses to sine waves, as well as adjusting phase relationships. Post-attenuator offset enables use of the full ±7.5 V offset range with small signals. The FG 504 output can be swept, or amplitude or frequency modulated by external signals. In addition, the FG 504 can supply internally generated linear- or logarithmic-swept frequencies of up to a 1000:1 range with convenient control of start and stop frequencies.

The FG 504 also provides trigger output, external voltage-control input, and sweep output.

Characteristics

Frequency Range – 0.001 Hz to 40 MHz, to 4 MHz with variable symmetry.

Symmetry Range – 7% to 93% variable.

Dial Accuracy – ≤3% to 4 MHz, ≤6% to 40 MHz.

Custom Frequency Change – Includes cap. for 20 Hz to 20 kHz.

Frequency Stability – ≤0.05% for 10 min., ≤0.1% for 1 hour, ≤0.5% for 24 hours, constant temperature.

Amplitude – 30 Vp-p into open circuit, 15 Vp-p into 50 Ω.

Attenuator in 10 dB Steps – 0 to –50 dB.

VAR Control – Variable control provides up to –20 dB additional attenuation.

Offset – ±7.5 V into open circuit, ±3.75 V into 50 Ω.

Amplitude Flatness – Sinewave and Triangle – ±0.5 dB to 40 kHz, ±2 dB to 40 MHz. Square – ±0.5 dB to 20 MHz, ±2 dB to 40 MHz.

Sinewave Distortion – ≤0.5%, 20 Hz to 40 kHz.

Square-Wave Response – ≤6 ns rise/fall fixed, 10 ns to 100 ms variable; ≤5% p-p +30 mV aberrations.

Triangle Linearity – ≥99%, 10 Hz to 400 kHz; ≥98%, 400 kHz to 4 MHz. ≥90%, 4 MHz to 40 MHz.

Trigger Output – +2 from 50 Ω.

External Trigger Input – Impedance ≥10 kΩ; Sensitivity ≤1 Vp-p; Trigger level; –1 to +10 V.

Phase Lock – 100 Hz to 40 MHz ±80° phase range.

Internal Sweep – Logarithmic or Linear. Separate Start/Stop Dials.

Duration – 0.1 ms to 100 s, in six decades.

Ramp Output – 0 V to 10 V from 1 kΩ.

Amplitude Modulation – 100% with ≈ 5 Vp-p, DC to 100 kHz; <5% distortion to 4 MHz at 70% modulation <10% to 40 MHz at 65% modulation.

Output Hold Mode – 0.001 to 400 Hz.

VCF – Up to 1000:1 Frequency change with 10 V external signal. Slew rate ≥0.3 V/ms.

Environmental – Operating: 0 to 40°C (Forced air required for 40 to 50°C). Non-operating: –40 to +75°C.

ORDERING INFORMATION

FG 5010
20 MHz Function Generator **$4,495**
Includes: Instruction Manual (070-3467-01); Instrument Interfacing Guide (070-4613-00); Reference Guide (070-3561-00).

FG 504
MHz Function Generator **$3,695**
Includes: Instruction Manual (070-2655-00).

WARRANTY-PLUS SERVICE OPTIONS

Opt. M7 – Calibration Service
FG 5010 ..... **+$280**
FG 504 ..... **+$225**

Opt. M9 – Repair Protection
FG 5010 ..... **+$380**
FG 504 ..... **+$380**

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

GPIB IEEE-488 — The FG 5010 complies with IEEE Standard 488.1-1987, and with Tektronix Standard Codes and Formats.

Function Generators

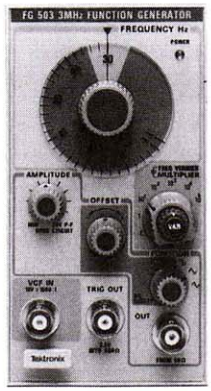
Signal Sources

Low Cost, Manual, General Purpose Plug-In Modules.

FG 503
- 1.0 Hz to 3 MHz
- Three Waveforms
- Up to 20 Vp-p Output
- Up to ±7.5 V Offset
- VCF

FG 502
- 0.1 Hz to 11 MHz
- Five Waveforms
- VCF and Gated Burst

FG 501A
- 0.002 Hz to 2 MHz
- 30 V Peak-to-Peak, 13 V Offset
- 5% to 95% Variable Symmetry
- Trigger or Gate, Slope
- 60-dB Step Attenuator
- ≤0.25% Sine-Wave Distortion
- ≤25 ns Rise/Fall



FG 503

FG 503

The FG 503 Function Generator provides high-quality low-distortion sine, square, and triangle waveforms. Six decade frequency multiplier steps, a custom position for user-determined frequency multiplication, a dial calibrated from 1.0 to 30 (uncalibrated from 0.1 to 1.0), and a frequency vernier control working together to select frequencies in overlapping ranges from 1 Hz to 3 MHz. The output frequency can be swept over a 1000:1 ratio by an external voltage. Output amplitude and offset controls are provided. A trigger output is available for controlling external devices or equipment. Amplitude up to 10 V peak-to-peak can be developed across a 50 Ω load (20 V peak-to-peak open circuit). Selectable offset up to 3.75 VDC across 50 Ω (7.5 VDC open circuit) is also featured.

Characteristics (FG503)

Frequency Range – 1 Hz to 3 MHz (0.01 Hz to 5 MHz usable).

Symmetry – 50% fixed.

Dial Accuracy – ±5% of F.S 1 Hz to 3 MHz.

Custom Frequency Range – With user installed cap.

Frequency Stability – ≤0.05% to 10 mins. ≤0.1% for 1 hour, ≤0.5% for 24 hours, constant temperature.

Amplitude – 20 Vp-p into open circuit, 10 Vp-p into 50 Ω.

Offset – ±7.5 V into open circuit, ±3.75 V into 50 Ω.

Amplitude Flatness – Within ±2 dB referenced at 10 kHz.

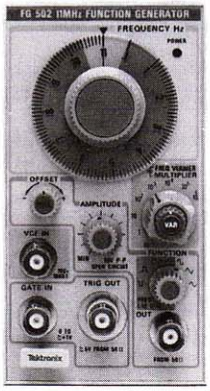
Sinewave Distortion – ≤0.5% to 30 kHz, ≤1% to 300 kHz, ≤2.5% to 3 MHz.

Square Wave Response – ≤60 ns rise/fall; ≤3% p-p aberrations. (50 Ω load).

Triangle Linearity – Typically ≥ 99%, 1 to 100 kHz; ≥95%, 100 kHz to 3 MHz.

Trigger Output – +2.5 to 600 Ω load.

VCF – Up to 1000:1 frequency change with 10 V external signal. Slew rate ≥0.3 V/ms.



FG 502

FG 502

The FG 502 Function Generator provides low-distortion sine, square, and triangle waveforms, and positive or negative ramps and pulses. Output frequency is continuously variable from 0.1 Hz to 11 MHz. The high-frequency range from 1 to 11 MHz permits the versatility of the function generator to be extended into the medium radio frequency range. VCF input permits the FG 502 to be used as a sweep generator or as an FM generator.

External-gate input permits the FG 502 output in any of its modes to be controlled by an externally supplied pulse to generate bursts of various output waveforms. The FG 502 is used in wireless or radio remote-control equipment and in certain phases of the telephone industry.

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

Function Generators

Signal Sources

FG 503
FG 502
FG 501A

Characteristics (FG502)

Frequency Range – 0.1 Hz to 11 MHz.

Dial Accuracy – ≤3% to 1 MHz, ≤5% to 10 MHz.

Frequency Stability – ≤0.05% for 10 min., ≤0.1% for 1 hour, ≤0.5% for 24 hours, constant temperature.

Amplitude – 10 Vp-p into open circuit, 5 Vp-p into 50 Ω.

Offset – ±5 V into open circuit, ±2.5 V into 50 Ω.

Amplitude Flatness – Sinewave, ≤ ±1.5 dB referenced at 10 kHz; Triangle and squarewave, ±3 dB referenced to sinewave.

Sinewave Distortion – ≤0.5% to 50 kHz; Harmonics ≤ −30 dB at all other frequencies.

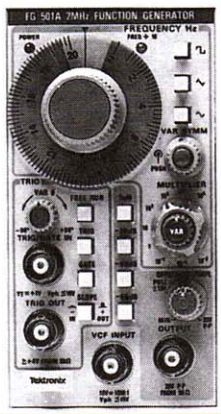
Square Wave Response – ≤ 20 ns rise/fall; ≤3% p-p aberrations.

Triangle Linearity – Typically ≥99%, 0.1 to 110 kHz >97%, 100 kHz to 1.1 MHz; ≥95%, 1 to 11 MHz.

Trigger Output – +2.5 to 50 Ω load.

External Input – Impedance ≈ 1 kΩ; ≥ +2 V gate signal required.

VCF – Up to 1000:1 frequency change with 10 V external signal. Slew rate ≥ 0.3 V/ms.



FG 501A

FG 501A

The FG 501A provides low-distortion outputs from 0.002 Hz to 2 MHz. It is capable of generating five basic waveforms – sine, square, triangle, ramp, and pulse – at output levels up to 30 V peak-to-peak with up to ±13 V of offset from a 50 Ω source. Waveform triggering and gating are provided with a variable phase control to permit up to ±90° of phase shift for generating haver-sines, sine pulses, and haver triangles. A step attenuator provides 60 dB of output signal attenuation in 20 dB steps with an additional 20 dB of variable attenuation. Variable symmetry from 5% to 95% provides ramps and pulses. Pulse rise time is ≤25 ns. Audio sine-wave distortion is ≤0.25 and audio amplitude flatness is within 0.1 dB.

Characteristics (FG501A)

Frequency Range – 0.002 Hz to 2 MHz.

Symmetry Range – ≤5% to ≥95% variable.

Dial Accuracy – ≤3%, 20 to 2 on dial.

Frequency Stability – ≤0.05% for 10 min., ≤0.1% for 1 hour, ≤0.5% for 24 hours, constant temperature.

Amplitude – 30 Vp-p into open circuit, 15 Vp-p into 50 Ω.

Offset – ±13 V into open circuit, ±6.5 V into 50 Ω.

Attenuator (dB) in 20 dB Steps – 0 to −60.

Attenuator with AMPL Control – >20 dB additional.

Amplitude Flatness – Sinewave, ±0.1 dB 20 Hz to 20 kHz; ±0.5 dB to 1 MHz; ±1 dB to 2 MHz. Triangle, ±0.5 dB 20 Hz to 200 kHz, ±2 dB to 2 MHz. Square wave, ±0.5 dB 20 Hz to 2 MHz.

Sinewave Distortion – ≤0.25% 20 Hz to 20 kHz; ≤0.5% to 100 kHz; Harmonics, ≤ −30 dB to 2 MHz.

Square Wave Response – ≤25 ns rise/fall; <3% p-p aberrations.

Triangle Linearity – ≥99%, 20 Hz to 200 kHz, ≥97% to 2 MHz.

Trigger Output – ≥ +4 V from 50 Ω.

External Input – Impedance ≈2 kΩ; +1 V ±20% gate signal required.

VCF – Up to 1000:1 frequency change with 10 V external signal. Slew rate ≥0.3 V/ms.

ORDERING INFORMATION

FG 503
3-MHz Function Generator **$790**
Includes: Instruction Manual (070-1727-01).

FG 502
11-MHz Function Generator **$1,250**
Includes: Instruction Manual (070-1706-01).

FG 501A
2 MHz Function Generator **$1,095**
Includes: Instruction Manual (070-2957-00).

WARRANTY-PLUS SERVICE OPTIONS

Opt. M7 – Calibration Service
FG 501A ..... **+$125**
FG 502 ..... **+$115**
FG 503 ..... **+$90**

Opt. M9 – Repair Protection
FG 501A ..... **+$155**
FG 502 ..... **+$145**
FG 503 ..... **+$110**

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

Pulse Generators

Signal Sources

CONTENTS

PULSE GENERATORS
General Information....306
PG 2010....308
PG 2011....308
PG 2012....308
PG 5110....310
PG 508....310
PG 503....312
PG 502....312
PG 501....313
HFS 9000....314

Pulse Generators

Whether testing wide-band systems, simulating data transmission signals, or driving a laser, the TM 500/TM 5000 series Pulse Generators have the required capabilities to meet your needs.

The selection guide below shows the broad line of products offered, from the very versatile PG 5110 Programmable 50 MHz Pulse Generator to the fast PG 503, 250 MHz 200 ps Manual Pulse Generator. The product line also has a low cost PG 501 50 MHz Manual Pulse Generator and a combination Pulsed/Function Generator, the PFG 5101.

Paired pulses can be generated at selected repetition rates with delay control capability available for determining the time between the two pulses – a useful means by which to evaluate a circuit's ability to differentiate between two closely spaced pulses.

Pulse shaping capabilities is another requirement found in many applications. For example, typical rise and fall times vary widely between logic families and in order to accurately simulate logic transactions, variable rise and fall times are necessary.

Faster-than-specified drive signals can cause problems through capacitive coupling to adjacent circuitry. Conversely, slower-than-specified drive signals to a CMOS gate will cause its dissipation to increase greatly during each transition. Adjustable rise and fall times make it possible to avoid these undesirable conditions.

Controllable rise and fall times are also useful in determining the characteristics of edge-triggered devices.

The Tektronix PG 5110 meets an impressive range of pulse generation requirements from 0.1 Hz to 50 MHz – single or dual channel, on the bench or in a system, and under either local or programmable control. With its easily mastered, menu-driven interface, the PG 5110 delivers maximum functionality – in the hands of a line technician or design engineer.

The general purpose, yet versatile PG 508 features independently variable rise and fall times for close approximations of real world events. The PG 503 offers fast 200 ps transition times for testing the new high-speed ECL and GaAs logic families. The PFG 5105/5505 offers pulse and function capability in a GPIB programmable instrument. These multipurpose generators can also be used for stimulus of high-impedance MOS, HTL, and CMOS logic circuits.

In 50 Ω systems, the repetition rates, amplitudes, and transition times of the PG 501 and PG 502 are designed to be compatible with common TTL, DTL, and ECL circuits.

Pulse Generators

Signal Sources

PG 501 | PG 502 | PG 503 | PG 508 | PG 5110

PULSE GENERATOR SELECTION GUIDE

	PG 5110	PFG 5105 PFG 5505	PG 508	PG 501	PG 502	PG 503	PG2010	PG2011	PG2012
Pulse Period	20 ns to 10 s	83 ns to 83.3 s	≤20 ns to ≥200 ms	≤20 ns to ≥200 ms	≤4 ns to ≥100 ms	≤4 ns to ≥100 ms	20 ns to 10 s	20 ns to 10 s	20 ns to 10 s
Pulse Duration	10 ns to 9.90000 s	40 ns to 99.9 ms	≤10 ns to ≥100 ms	≤10 ns to ≥100 ms	≤2 ns to ≥50 ms	≤2 ns to ≥50 ms	10 ns to 9.90000 s	10 ns to 9.90000 s	10 ns to 9.90000 s
Duty Factor	1 to 9.89990%	Up to 85%	≥70% at 0.2 µs period ≥50% at 20 ns period	≥70% at 0.2 µs period ≥50% at 20 ns period	≥50%	≥50%	1 to 99%	1 to 99%	1 to 99%
Pulse Delay	0 ns to 10 s	40 ns to 99.9 ms	≤5.5 ns to ≥ 100 ms	Fixed, 8 ns	Fixed, 17 ns		0 ns to 9.89999 s	0 ns to 9.89999 s	0 ns to 9.89999 s
Double Pulse Period	40 ns to 10 s	166 ns to 83.3 s	NA	NA	NA	NA	40 ns to 10 s	40 ns to 10 s	40 ns to 10 s
Transition Times	Variable from ≤6 ns to 10 ms, leading and trailing	<15 ns at full output, leading and trailing	Variable from <5.5 ns to ≥50 ms leading and trailing	≤3.5 ns, leading and trailing	≤1 ns, leading and trailing	≤200 ps, 20–80%, 1 V range, leading and trailing	Selectable 250 ps, 800 ps, 1.8 ns, leading and trailing	Variable, 5.5 ns to 10 ms, leading and trailing	CH. 1: same as PG2010; CH. 2: same as PG2011
Aberrations	≤5% + 50 mV into 50 Ω for levels between ±5 V	<8% ± 20 mV from 3.4 V to 9.99 V output	<5% + 50 mV into 50 Ω	±3.5% into 50 Ω	±5% (duration ≥ 5 ns)	±8% at 1 V steps	≤10% p-p for p-p voltage ≥1.25 V; otherwise 150 mV p-p	≤±5% for pulse levels between ±5 V	CH. 1: same as PG2010; CH 2: same as PG2011
Amplitude (Vp-p into 50 Ω)	10 V, ±10 V window	9.99 V	≥10 V, ±10 V window	≥5 V	5 V, ±5 V window	2.5 V, ±2.5 V window	±2.5 V in two ranges	±10 V in two ranges	CH. 1: same as PG2010; CH.2: same as PG2011
Accuracy Period	±1% of setting ±1 ns						±1% of setting ±1 ns	±1% of setting ±1 ns	±1% of setting ±1 ns
Width & Delay	±2% of setting ±2 ns						±2% of setting ±2 ns	2% of setting ±2 ns	2% of setting ±2 ns
Jitter	≤0.1% of setting + 100 ps						≤0.1% of setting + 100 ps	≤0.1% of setting + 100 ps	≤0.1% of setting + 100 ps
Trigger Sensitivity	150 mV p-p min, DC to 50 MHz						150 mV p-p min, DC to 50 MHz	150 mV p-p min, DC to 50 MHz	150 mV p-p min, DC to 50 MHz
IEEE Std 488.1	Yes	Yes					Yes	Yes	Yes
Complementary Outputs			No	Yes	No	Yes			
Pulse Coincidence			N/A	≤1 ns at 50% amplitude	N/A	N/S			
Output Controls			Independent pulse top and pulse bottom, normal or Preset	Independent for positive output and negative output	Independent pulse top and pulse bottom	Independent pulse top and pulse bottom			
Manual Trigger			Yes	No	Yes	Yes			
Duration Mode			Yes	Yes	Yes	Yes			
Gate Mode			Yes	No	No	No			

PG2010
PG2011
PG2012

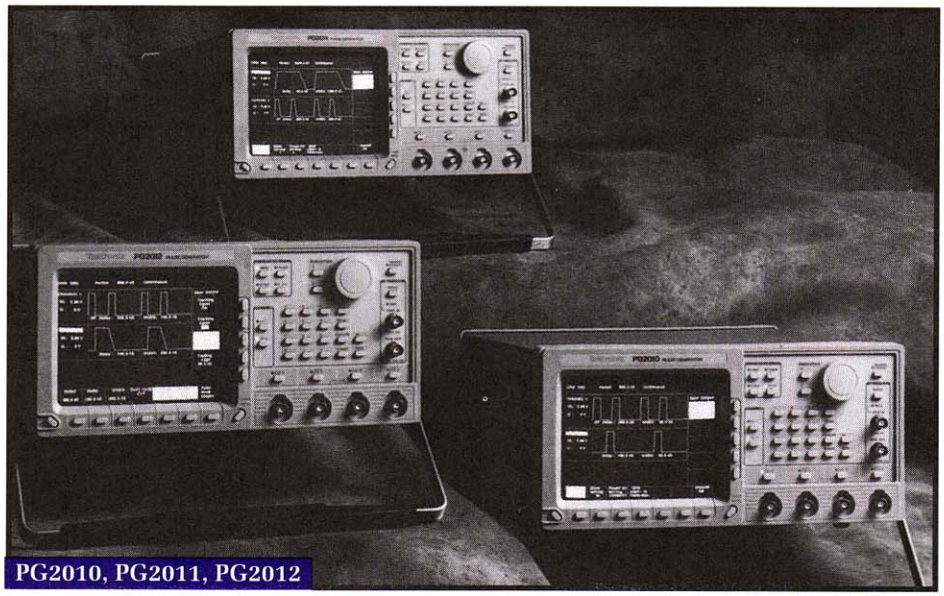
Programmable Pulse Generators

Signal Sources

Unique interface simplifies creation of pulse waveforms.

PG2010/2011/2012

- Graphic User Interface with Output Waveforms and Parameters on the Display
- Selectable 250 ps, 800 ps or 1.8 ns with 2.5 V Output into 50 Ω
- Variable 5.5 ns to 10 ms Transition Time with 10 V Output into 50 Ω
- 50 MHz Repetition Rate
- 1% Period Accuracy
- Dual Channel Capability
- GPIB IEEE 488.2



PG2010, PG2011, PG2012

PG2010, PG011, PG2012

The 2000 Series family provides three new, fully programmable pulse generators designed for precision high performance applications in automatic test or on the bench. The products meet the needs of a wide range of applications from analog to high-speed logic or mixed technologies.

Operation, especially for oscilloscope or logic analyzer users, is made easy with a convenient High Resolution Graphic display utilizing a menu-driven user interface. A waveform is displayed on the monitor for each pulse generator output channel.

Members of the family provide a 50 MHz repetition rate, 1-2% accuracy depending on the parameter, 20 V output from the variable transition time units with transition times as fast as 250 ps from the selected transition products.

Each pulse generator is specified to operate over 0°C to 50°C, useful for ATE systems. The same higher accuracy specification typically limited to the 20°C to 30°C by others is covered the full temperature range in the PG2010 family.

One or two channel operation is possible. The PG2010 and PG2011 are single-channel instruments. Dual-channel products are available in the PG2010 Opt 2, PG2011 Opt 2 and PG2012. All are designed as parameter independent, synchronous outputs. Their delay capability will allow phase shifted signals.

The PG2010 and channel 1 of the PG2012 provide selection of 250 ps, 800 ps and 1.8 ns rise and fall transition times. Fast 200 ps transitions are guaranteed for output voltages up to 1.25 V in the 250 ps mode. Each selectable fast channel provides simultaneous normal and complement outputs.

Variable transition outputs from 5.5 ns to 10 ms are available in the PG2011 and channel 2 of the PG2012.

Characteristics

Characteristics describe the pulse generators warranted performance after a 20 minute warmup, into 50 Ω load. To maintain warranted specifications, the enhanced accuracy must be on and Internal Cal performed with ±5°C of the current ambient operating temperature. The ambient specification covers the range of 0°C to 50°C.

Common Specifications

(Timing with minimum transitions)

PERIOD

Range – 20 ns to 10 s.

Accuracy – ±1% of setting ±1 ns.

Maximum Jitter – <0.05% of setting +30 ps rms.

DELAY, DOUBLE PULSE, WIDTH

Delay Range – 0.0 ns – 9.89990 s.

Width Range – 10.0 ns – 9.90000 s.

Accuracy – ±2% of setting ±2 ns.

Maximum Jitter – ≤0.05% of setting +30 ps rms.

TRIGGER/GATE INPUT

Sensitivity – 150 mV p-p min., DC to 50 MHz.

Min. Pulse Width – 10 ns.

Threshold – Range: ±9.99 V.
Resolution: 3 digit (10 mV).
Accuracy: ±5% of setting ±25 mV.
Slope: Positive (+) or Negative (–).
Counted burst: 2 to 999,999 cycles per burst.

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

GPIB IEEE-488 — The PG 2000 Series complies with IEEE Standard 488.1-1987, and with Tektronix Standard Codes and Formats.

Programmable Pulse Generators

Signal Sources

PG2010
PG2011
PG2012

INTERNAL TRIGGER

Resolution – Up to 4 digits, limited to 100 ns.

Repetition Rate – 100 ns – 99.995 ns.

Accuracy – ±0.01% ±1 ns.

Jitter – ≤0.05 of setting +30 ps rms.

GENERAL

Power – 150 watts.

Temperature – Operating: 0°C to + 50°C.

Storage: –20°C to +60°C.

Source Impedance – 50 Ω.

TIMING (MINIMUM TRANSITIONS)

Single Pulse Mode – Period*1: 20 ns to 10 s.
Width: 10 ns to 9.90000 s.
Delay: 0 ns to 9.89999 s.

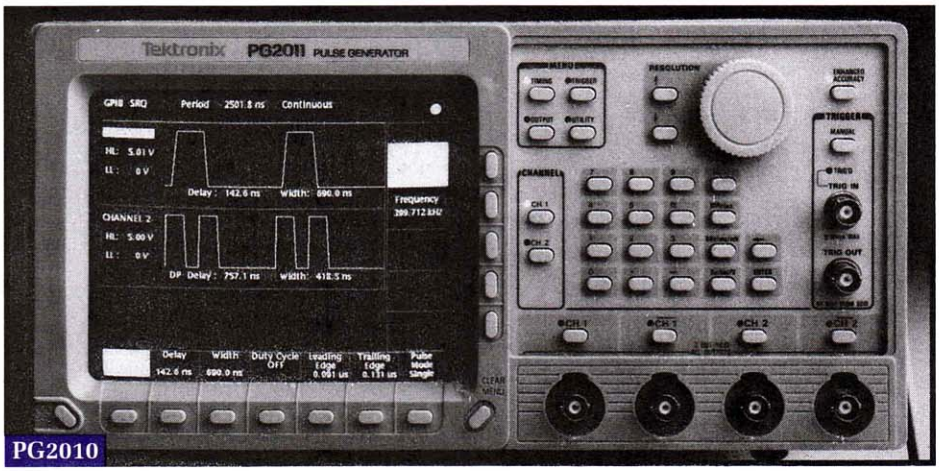
Double Pulse Mode – Period*1: 40 ns to 10 s.
Width: 10 ns to 4.90000 s.
Delay: (Period* 0.99) - (Width + 8 ns), but not >9.80000 s.

Accuracy – Period: ±1% of setting ±1 ns.
Width and Delay: ±2% of setting ±2 ns.

Maximum Jitter – Period, Width and Delay: ≤0.1% of setting +100 ps.

PHYSICAL CHARACTERISTICS

Dimensions	mm	in.
Width	344	13.5
Height	166	6.5
Depth	489	18.9
Weight	**kg**	**lb**
Net	8.5	19.0



Timing (continued)

Output Characteristics – (into 50 Ω)*1:

Output Levels		PG2010	PG2011	PG2012
High Level Range		–1.2 V to +2.5 V	–9.5 V to +10.0 V	CH 1 same as PG2010
Low Level Range		–2.5 V to +1.9 V	–10.0 V to +9.5 V	CH 2 same as PG2011
Amplitude		0.6 V min, 2.5 V max	0.5 V min, 10 V max	CH 1: 0.6 V min, 2.5 V max CH 2: 0.5 V min, 10 V max
Level Accuracy		±1% of level setting ±2% p-p amplitude	±1% of level setting ±2% p-p amplitude	±1% of level setting ±2% p-p amplitude
Transition Times*1				
Leading edge	(CH 1)	Selectable 250 ps, 800 ps, 1.8 ns	Variable 5.5 ns to 10 ms*2	Selectable 250 ps, 800 ps, 1.8 ns
	(CH 2)	Selectable 250 ps, 800 ps, 1.8 ns	Variable 5.5 ns to 10 ms*2	Variable 5.5 ns, to 10 ms*2
Trailing edge	(CH 1)	Same as leading edge	Variable 5.5 ns to 10 ms*2	Same as leading edge
	(CH 2)	Same as leading edge	Variable 5.5 ns to 10 ms*2	Variable 5.5 ns to 10 ms*2
Preshoot, Overshoot, Ringing				
		≤150 mV for amplitude of ≤1.25 V ≤10% of amplitude for amplitude >1.25 V	≤5%, +50 mV for pulse levels between ±5 V	CH 1 same as PG2010 CH 2 same as PG2011

**1 The 250 ps transition edge is specified from 20 to 80% of the pulse amplitude. All others are specified from 10 to 90%.*
**2 Leading and trailing edge can be set independently.*

ORDERING INFORMATION

PG2010
Single Channel Programmable Pulse Generator **$6,450**
Includes: Selectable 250 ps, 800 ps and 1.8 ns transition times.

PG2011
Single Channel Programmable Pulse Generator **$5,950**
Includes: Variable 5.5 ns to 10 ms transition times.

PG2012
Dual Channel Programmable Pulse Generator **$8,995**
Includes: CH 1 like the PG2010 and CH 2 like the PG2011.

Opt. 2 – Second channel
PG2010 ..... **+$2,450**
PG2011 ..... **+$1,850**

Opt. 1R – Rackmount ..... **+$350**

Opt. B1 – Service Manual ..... **+$55**

INTERNATIONAL POWER PLUG OPTIONS

Opt. A1 – Universal Euro 220 V, 50 Hz ..... **NC**
Opt. A2 – United Kingdom 240 V, 50 Hz ..... **NC**
Opt. A3 – Australian 240 V, 50 Hz ..... **NC**
Opt. A4 – North American 240 V, 60 Hz ..... **NC**
Opt. A5 – Switzerland 220 V, 50 Hz ..... **NC**

WARRANTY PLUS SERVICE OPTIONS

Opt. M7 – Calibration Service.
PG2010 ..... **+$300**
PG2011 ..... **+$230**
PG2012 ..... **+$310**

Opt. M9 – Repair Protection.
PG2010 ..... **+$480**
PG2011 ..... **+$370**
PG2012 ..... **+$490**

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

GPIB IEEE-488 — The PG 2000 Series complies with IEEE Standard 488.1-1987, and with Tektronix Standard Codes and Formats.

PG 5110
PG 508

Pulse Generators
Signal Sources

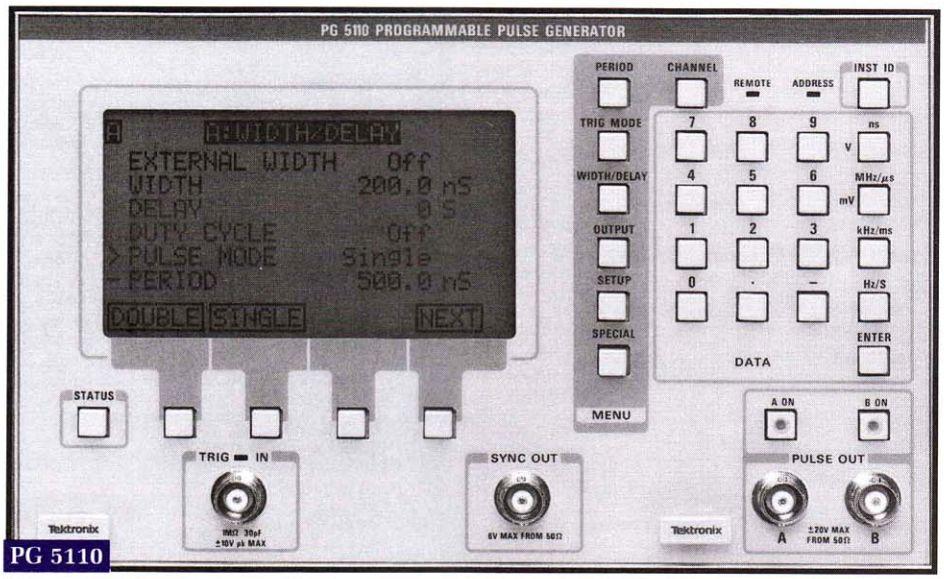
Our Lowest Cost 50 MHz Modular Pulse Generators.

PG 5110

- Two Independent 50 MHz Output Channels
- Repetition Rates from 0.1 Hz to 50 MHz (periods from 20 ns to 10 s)
- Variable Transitions from 6 ns to 10 ms
- Clear Large Graphic Display for Convenient Operation
- 99 Stored Front-panel Settings Capability with Non-volatile Memory

PG 508

- 5 Hz to 50 MHz
- Independently Variable Rise and Fall Times to 5 ns
- 20 V Output in a ±20 V Window, 10 V into 50 Ω
- Normal or Complement Output
- Wide Choice of Trigger Capabilities



PG 5110

The PG 5110 is a fully programmable pulse generator with pulse outputs from 0.1 Hz to 50 MHz in single or dual channel versions. The easily mastered menu-driven front panel, with storage for 99 settings, provides real benefits to either a test technician or design engineer.

The majority of the parameters can be varied independently for each output channel. Pulse widths can vary from 10 ns to 10 s and delays from 0 ns to 10 s, both with up to 6 digits of resolution. For worst case testing and characterization, transitions can be varied from 6 ns to 10 ms.

Predefined levels for TTL, CMOS or ECL are provided as well as adjustable levels from –10 V to +10 V with a 10 V amplitude pulse. Extremely good timing accuracies are achieved through internal calibration which is performed every time the parameter setting is changed. Operating modes include continuous, triggered, gated, and burst from 2 to 999,999 cycles.

The blank panel version (Opt. 01) makes it ideal for systems applications. A TM 5000 mainframe is required.

Characteristics

PERIOD (COMMON TO BOTH CHANNELS)

Single Pulse Range – 20 ns – 10 s (50 MHz – 0.1 Hz repetition rate).

Double Pulse Range – 40 ns–10 s in Paired Pulse per period mode (25 MHz–0.1 Hz repetition rate).

Resolution – 6 digits limited to 0.1 ns.

Accuracy – ±1% of setting ±1 ns.

Jitter – ≤(0.1% of setting + 50 ps) on fastest range.

WIDTH (INDEPENDENT FOR EACH CHANNEL)

Range – 10 ns–9.99999 s.

Resolution – 6 digits limited to 0.1 ns.

Accuracy – ±2% of setting ±2 ns.

Jitter – ≤(0.1% of setting + 50 pS) decreasing to 0.005% on slowest range.

DELAY (INDEPENDENT FOR EACH CHANNEL)

Range – 0 ns–9.99999 s.

Resolution – 6 digits limited to 0.1 ns.

Accuracy – ±2% of setting ±2 ns.

Jitter – ≤(0.1% of setting + 50 ps), decreasing to 0.005% on slowest range.

DUTY CYCLE PERFORMANCE (INDEPENDENT FOR EACH CHANNEL)

Range – 1–99%.

Resolution – 0.1% (3 digits). Square Wave is not selectable directly as a mode; use DUTY = 50%.

Accuracy – Limited by width and pulse accuracy.

TRANSITION TIMES (INDEPENDENT FOR EACH CHANNEL)

Transition Time – 6 ns–10 ms (variable), measured at +5 V to +2 V and –5 V to –2 V. Leading edge and trailing edge settable separately.

Resolution – 3 digits, limited to 0.1 ns.

Accuracy – ±5% of setting ±2 ns.

Linearity – Less than 5% deviation from a straight line.

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

GPIB IEEE-488 The PG 5110 complies with IEEE Standard 488.1-1987, and with Tektronix Standard Codes and Formats.

Pulse Generators

Signal Sources

PG 5110
PG 508

AMPLITUDE (INDEPENDENT FOR EACH CHANNEL)

High Level Range – –9.49 V – +10 V, into 50 Ω load (typically –18.98 V – +20 V into open circuit).

Low Level Range – –10 V – + 9.49 V, into 50 Ω load (typically –20 V – +18.98 V, into open circuit).

Pulse Amplitude Range – 0.5 V minimum to 10 Vp-p maximum into 50 Ω load (1 V minimum to 20 Vp-p maximum into open circuit).

Resolution – 3 digits limited to 10 mV.

Accuracy – ±1% of level setting ±2% of p-p amplitude ±50mV into 50 Ω load.

Aberrations – ≤5% + 50 mV into 50 Ω load for pulse levels between ±5 V.

Setting Time – 50 ns + transition time.

Output Source Resistance – 50 Ω ±2.5 Ω.

TRIGGERING/GATING INPUT

Sensitivity – 150 mV p-p minimum, DC –50 MHz.

Minimum Input Pulse Width – 10 ns; 250 mV amplitude required for triggering.

Maximum Repetition Rate – 50 MHz.

Input Impedance – 1 MΩ ±5%; ≈30 pf.

Maximum Input Voltage – ±10 VDC plus peak AC.

THRESHOLD

Range – ±9.99 V.

Resolution – 3 digits (10 mV).

Accuracy – ±5% of setting ±25 mV.

Slope Selection – Positive (+) slope for triggering and positive-true for gating; Negative (–) slope for triggering, negative-true for gating.

Counted Burst – 2–999,999 cycles per burst.

INTERNAL TRIGGER

Repetition Rate Range – 100 ns–999.99 s.

Resolution – Up to 4 digits, limited to 100 ns.

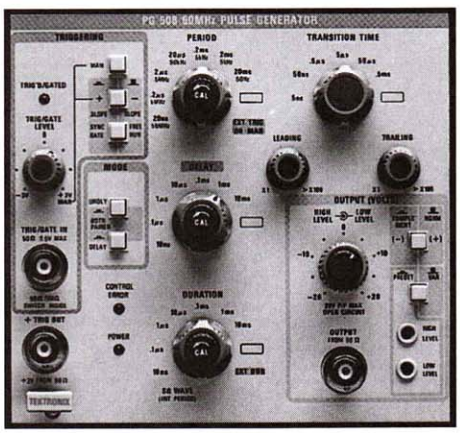
Repetition Rate Accuracy – ±0.01% ±1 ns.

Jitter – ≤(0.1% of setting +50 ps).

GENERAL

Environmental – Operating: 0 – 50°C. Non-operating: –20 to +60°C.

Power Consumption – 130 W total.



PG 508

The PG 508 is a versatile, general-purpose, 50 MHz pulse generator. The circuitry of the PG 508 is designed so that rise and fall waveforms closely simulate real-world waveforms. This capability is particularly useful in research-and-development applications demanding versatility in rise and fall times, such as testing of amplifiers, slew-rate testing, comparator simulation, and logic-circuitry performance tests.

For example, controllable rise and fall times are extremely desirable when working with CMOS where logic power consumption increases with slower rise times. Also, variable rise and fall times are used to reduce ringing (transient distortion) problems associated with too fast a pulse.

The PG 508 features a vernier control on the rise and fall times controllable from 100 to 1. This completely overlaps the next decade range and increases the PG 508's versatility in applications simulating different rise and fall times, especially the output of nonlinear devices. This overlap feature can also be used to generate a ramp signal or simulate unequal slew rates in an amplifier.

Also adding to the simplicity of using the PG 508 is the capability of changing output amplitude while variable rise and fall times remain constant.

Characteristics

Pulse Period – ≤20 ns to ≥ 200 ms (50 MHz to 5 Hz).

Pulse Duration – ≤10 ns to ≥100 ms.

Duty Cycle – ≥70% to 0.2 µs period, ≥50% at 20 ns period.

Pulse Delay – ≤10 ns to 100 ms.

Transition Times – <5.5 ns to ≥50 ms, independently variable up to 100:1.

Aberrations – ≤5% +50 mV into 50 Ω for pulse levels between ±5 V. 10% +50 mV above this.

Amplitude – ≥10 Vp-p into 50 Ω, ±10 V window.

Trigger Level – +3 V to –3 V, 80 mV p-p sensitivity to 10 MHz, 250 mV p-p to 50 MHz.

Slope – + or –.

Trigger Output – ≥ +2 V from 50 Ω.

Square Wave Mode – Yes.

Double Pulse – Yes.

Normal/Complement – Yes.

Manual Trigger – Yes.

Duration Mode – Yes.

Gate Mote – Yes.

ORDERING INFORMATION

PG 5110
50 MHz Programmable Pulse Generator **$5,200**
Includes: Instruction Manual (070-7740-00); Reference Guide (070-7743-00); Instrument Interface Guide (070-7742-00).

Opt. 01 – Blank Front Panel ..... **–$450**

Opt. 02 – Adds Channel B, converting the PG 5110 to a dual-channel instrument ..... **+$1,495**

PG 508
50 MHz Pulse Generator **$2,895**
Includes: Instruction Manual (070-2044-01).

WARRANTY-PLUS SERVICE OPTIONS

Opt. M7 – Calibration Services
PG 5110 ..... *1
PG 508 ..... **+$270**

Opt. M9 – Repair Protection
PG 5110 ..... *1
PG 508 ..... **+$360**

OPTIONAL ACCESSORIES

Service Manual – Order 070-7741-00 ..... **$50**

Rear Interface Cable Set – Order 118-8569-00 ..... **$250**

[1]Contact your local Tektronix representative for price information.

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

GPIB IEEE-488 — The PG 5110 complies with IEEE Standard 488.1-1987, and with Tektronix Standard Codes and Formats.

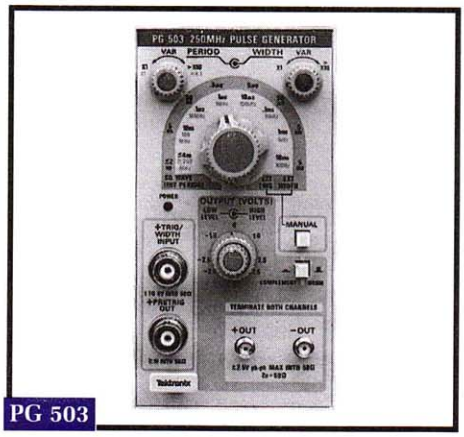
PG 503
PG 502

Pulse Generators
Signal Sources

Whether testing wide band systems or simulating data transmission signals or driving a laser, these low cost generators will meet your needs efficiently.

PG 503
- 10 Hz to 250 MHz
- ≤200 ps Rise Time
- 2.5 V Output, ±2.5 V Window
- Independent Pulse Top and Bottom Level Controls
- Complementary Outputs
- Manual Trigger Button

PG 502
- 10 Hz to 250 MHz
- 1 ns Rise Time
- 5 V Output, ±5 V Window
- Independent Pulse Top and Bottom Level Controls
- Selectable Internal Reverse Termination
- Manual Trigger Button



PG 503

The PG 503 is a 250 MHz general purpose, fast rise pulse generator useable in either the TM 500 or TM 5000 series mainframes. It is identical to the PG 502 except for output which is now differential; the risetime is faster, and the amplitude range is 2.5 V within a ±2.5 V window. The fast risetime makes the PG 503 ideal for testing the new high-speed ECL and GaAs logic families.

Characteristics

Pulse Period – ≤4 ns to ≥100 ms (250 MHz to 10 Hz).

Pulse Duration – ≤2 ns to ≥50 ms.

Duty Cycle – ≥50%.

Transition Times – <200 ps fixed (20% to 80%).

Aberrations – ≤150 mV p-p for voltages ≤1.25 Vp-p, ≤10% p-p for voltages ≥1.25 Vp-p.

Amplitude – ≥ ±2.5 Vp-p into 50 Ω, ±2.5 V window.

Trigger Level – +1 V.

Slope – + only.

Trigger Output – ≥ ±1 V from 50 Ω.

Square Wave Mode – Yes.

Complementary Outputs – Yes.

Normal/Complement – Yes.

Manual Trigger – Yes.

Duration Mode – Yes.

PG 502

The PG 502 is a 250 MHz Pulse Generator with rise and fall times of less than 1 ns. It has a single output with independent controls of the top and bottom pulse levels to control pulse amplitude and offset. A wide range of pulse period and pulse duration settings are provided through independent controls. Front panel switches are provided for normal output or complement and back termination of 50 Ω. The fast repetition rate makes the PG 502 ideal for design and testing of fast logic and switching circuits.

Characteristics

Pulse Period – ≤4 ns to ≥100 ms (250 MHz to 10 Hz).

Pulse Duration – ≤2 ns to ≥50 ms

Duty Cycle – ≥50%.

Transition Times – <1 ns fixed.

Aberrations – Within 5% p-p at 5 Vp-p.

Amplitude – ≥5 Vp-p into 50 Ω, ±5 V window.

Trigger Level – +1 V.

Slope – + only.

Trigger Output – ≥ +2 V from 50 Ω.

Square Wave Mode – Yes.

Normal/Complement – Yes.

Manual Trigger – Yes.

Duration Mode – Yes.

ORDERING INFORMATION

PG 503
250 MHz Pulse Generator **$3,995**
Includes: Instruction Manual (070-7935-00); Two SMA to BNC Adapters (015-1018-00); One SMA 50 Ω Termination (015-1022-00).

PG 502
250-MHz Pulse Generator **$3,495**
Includes: Instruction Manual (070-1598-01).

WARRANTY-PLUS SERVICE OPTIONS
Opt. M7 – Calibration Service
PG 502 ..... **+$155**
PG 503 ..... **+$200**

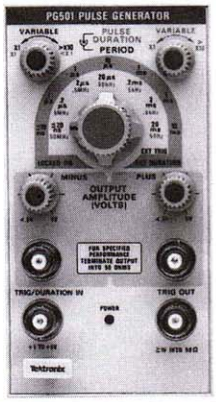
Opt. M9 – Repair Protection
PG 502 ..... **+$200**
PG 503 ..... **+$245**

RECOMMENDED PROBES
See Probes section for complete description.
P6062B – 1X/10X, DC to 100 MHz **$240**
P6108A – 10X, DC to 100 MHz **$145**
P6122 – 10X, DC to 100 MHz **$95**

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

Pulse Generators

Signal Sources



PG 501

PG 501

The PG 501 is a 50 MHz Pulse Generator featuring simultaneous plus and minus outputs, a wide range of pulse-period durations and duty factors, trigger output, and external trigger/duration input. Its performance and ease of operation make it well-suited to basic digital and analog applications.

An optional remote manual trigger generator is available, part number 016-0597-00.

Characteristics

Pulse Period – ≤20 ns to ≥200 ms (50 MHz to 5 Hz).

Pulse Duration – ≤10 ns to ≥100 ms.

Duty Cycle – ≥70% to 0.2 µs period, ≥50% at 20 ns period.

Transition Times – ≤3.5 ns fixed, ≤4 ns above 5 V.

Aberrations – Within 3.5% p-p at 5 Vp-p.

Amplitude – ≤0.5 V to ≥5 Vp-p into 50 Ω.

Pulse Coincidence – ≤1 ns at 50% amplitude.

Trigger Level – +1 V.

Slope – + only.

Trigger Output – ≥ +2 V from 50 Ω.

Square Wave Mode – Yes.

Complementary Outputs – Yes.

Duration Mode – Yes.

Manual (One-Shot) Trigger Assembly

For instruments that do not have a manual trigger (such as the PG 501), or where remote triggering is required, the Manual Trigger Assembly initiates a pulse or a full chain of events at the push of a button.

The Trigger Assembly produces a debounced output pulse nominally 2 ms in width and 3 V in amplitude (from 50 ohms) with rapid rise and fall times. It will send pulses as fast as the operator can cycle the pushbutton.

50 Ω Precision Coaxial Cable

The PG 502, PG 506A, and SG 503 are internally calibrated for use with this 3-ft., 50 Ω, coaxial cable into a 50 Ω load.

Rise Time Limiter

For use with the PG 502 Pulse Generator which has a pulse rise and fall time of less than one nanosecond. In some applications, such as TTL logic where slower rise time is needed, this fast pulse can be limited to six nanoseconds by using the rise time limiter.

PG 501

- 5 Hz to 50 MHz
- Simultaneous Plus and Minus Outputs
- 5 V and 3.5 ns into 50 Ω
- Independent Period and Duration Controls
- Trigger Out
- Optional Manual Trigger Generator

Our Lowest Cost 50 MHz Modular Pulse Generator with Complimentary Outputs.

ORDERING INFORMATION

PG 501
50 MHz Pulse Generator **$995**
Includes: Instruction Manual (070-1361-01).
50 Ω Cable – Order 012-0482-00 ..... **$35**
Trigger Generator – Order 016-0597-00 ..... **$400**
Rise Time Limiter – Order 015-0249-00 ..... **$220**

WARRANTY-PLUS SERVICE OPTIONS
Opt. M7 – Calibration Service **$90**
Opt. M9 – Repair Protection **$115**

RECOMMENDED PROBES
See Probes section for complete description.
P6062B – 1X/10X, DC to 100 MHz **$240**
P6108A – 10X, DC to 100 MHz **$145**
P6122 – 10X, DC to 100 MHz **$95**

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

HFS 9003
HFS 9009
HFS 9DG1
HFS 9DG2
HFS 9PG1
HFS 9PG2

Programmable Stimulus System

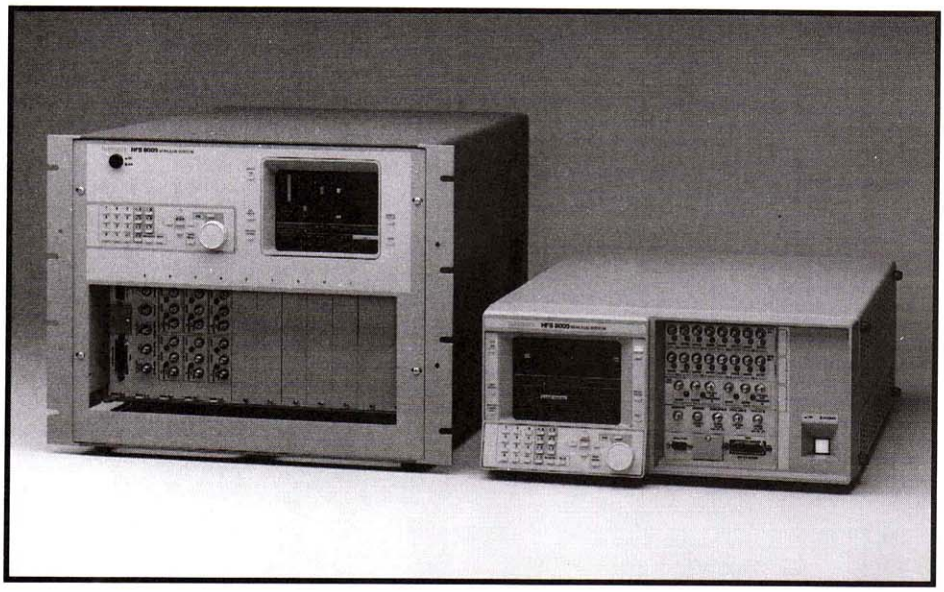
Signal Sources

All the stimulus you need in a single instrument.

The new Tektronix HFS 9000 Stimulus System combines the capabilities of a complete data generator, pulse generator, DC level source and switch matrix in a single instrument — it's the industry's first Data Time Generator.

HFS 9000

- Complete Stimulus Setup In Just Minutes
- Specify Data and Timing On Every Pin
- Up to 630 MHz Repetition Rate
- Fully Digital Implementation for Maximum Control and Flexibility
- Multi-Channel Architecture – Up to 640 or more Phase Locked Channels
- Independent Edge Placement
- Channel Deskew
- Precision Channel-to-Channel Timing Alignment
- 1 ps Timing Resolution
- GPIB (IEEE-488) Programmable
- Characterize CMOS, ECL, ACL, BiCMOS, and GaAs Devices
- Modular Construction allows Future Upgrade Capability



HFS 9000 Stimulus System

When product designs were simple, and time-to-market not so critical, designers could afford the days, or even weeks, necessary to assemble, program, debug and characterize the various elements of a stimulus system and its fixturing. As product design complexity and market pressures have increased, however, designers of high-speed, high-performance circuits simply cannot afford this expenditure in time.

Now there's a solution. With the new Tektronix HFS 9000 Stimulus Systems we've taken the pulse generator features of the HFS 9010/20/301*1, made them better, and added complete data generation capabilities as well. We've eliminated the need for a switch matrix since we have data and timing on every pin. And the need for a separate power supply is gone — the HFS 9000 has the ability to produce the DC levels needed to drive logic lines directly. Finally, all these capabilities are present on every pin simultaneously, so you get extremely flexible formatting. Now you can set up a complete stimulus system in minutes rather than hours or days, and test products more thoroughly throughout the development cycle.

DIGITAL ARCHITECTURE

The HFS 9000 Series products were designed as completely programmable digital instruments rather than being based on traditional monostable analog architecture. This allows more capability and flexibility in pulse edge placement without the restrictions that analog instruments commonly impose. Now you can adjust both Delay and Width from 0 to 20 µs over all frequencies.

MODULAR DESIGN

You can build a stimulus system with from 2 to 36 channels in one mainframe, and 640 or more channels across multiple phase-locked mainframes. Choose from the HFS 9003 mainframe with three-slot, 12-channel capability; or the HFS 9009 mainframe with nine-slot, 36-channel capability. Both systems can include the 4-channel HFS 9DG1 and 9DG2 Data Time Generator cards, as well as the 2-channel HFS 9PG1 and 9PG2 Pulse Generator cards in any combination.

All channels are slaved to a common clock, resulting in highly accurate channel-to-channel edge placement. This makes the HFS 9000 ideal for precise characterization and evaluation of synchronous devices having multiple, and possibly interactive, inputs.

FULL CHANNEL DESKEW CAPABILITY

All HFS 9000 channels have independent, wide deskew ranges to allow precise pulse alignment and timing at the device under test (DUT). Deskew compensates for the timing differences caused by cabling and fixturing so your analysis can be focused on the relative timing at the DUT.

**1 If you're familiar with the HFS 9010/20/30 Pulse Generators, these configurations are still available. Please contact your local Tektronix representative for price and ordering information.*

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

GPIB IEEE-488 — The HFS 9000 Series complies with IEEE Standard 488.1-1987, and with Tektronix Standard Codes and Formats.

Programmable Stimulus System

Signal Sources

HFS 9003	HFS 9DG2
HFS 9009	HFS 9PG1
HFS 9DG1	HFS 9PG2

1 PS TIMING RESOLUTION

No other system lets you generate whatever combination of signals is required, with data and timing on every pin with 1 ps resolution. Now you can create data buses, clocks, strobes, gated clocks, logic level sources, pseudorandom bits and other stimuli with unequaled accuracy. You can perform setup and hold time margin tests by providing the clock, data, set and reset signals to the DUT. And you can hold inactive signals at programmable high or low logic levels, eliminating the need for external DC voltage sources and microwave switches.

630 MHZ REPETITION RATE

Accurate and repeatable AC measurements of prop delay, setup and hold time, and maximum operating frequency (fmax) require fast rep rates and edge speeds. With repetition rates up to 630 MHz, the HFS 9000 is ideal for characterizing the most advanced logic families. And, it can be used for testing component compliance with the SONET telecommunications standard. Transition times as fast as 200 ps (20%-80%) enable repeatable and accurate testing of the highest-speed ECL and GaAs digital devices. Variable transition time control from 800 ps to 6 ns is also available with the appropriate output levels for testing advanced CMOS, BiCMOS and TTL logic families.

FULLY PROGRAMMABLE

Programmability is important in developing automated, repeatable tests in R&D, incoming inspection, and production of high-speed components. Therefore, the HFS 9000 offers full implementation of the new IEEE-488.2 standard and utilizes Tektronix Codes & Formats. GPIB/RS-232 ports provide for remote, fully programmable control. Coupled with a high-speed acquisition system, such as the 11801A Digital Sampling Oscilloscope, or the most advanced logic analysis system on the market – the Tektronix DAS 9200 Digital Analysis System – a fully automated test system can be developed with unequaled accuracy and repeatability.

PHASE LOCK MODE

Phase lock-in allows the internal timebase to be phase-locked to an external frequency source. This "supercharger" capability can be used to augment the speed performance of automated component test systems by creating synchronized signals as fast as 630 MHz.

CONFIGURATION OPTIONS

Card-modular design lets you adapt to any logic family from within the same mainframe. Choose the HFS 9DG1 Data Time Generator card and the HFS 9PG1 Pulse Generator card for 630 MHz bandwidth and <250 ps fixed rise-time. The 9DG1 provides four channels of stimulus, while the 9PG1 provides two. These two cards are ideal for ECL and GaAs device characterizations.

Or, choose the HFS 9DG2 Data Time Generator card and the HFS 9PG2 Pulse Generator card for up to 315 MHz bandwidth and variable transition times from 800 ps to 6 ns. The 9DG2 provides four channels of stimulus, while the 9PG2 provides two. These two cards are ideal for simulating TTL, CMOS and BiCMOS logic signals.

Combine these cards in any combination for testing a broad range of components or systems with mixed logic families.

APPLICATIONS

From verifying critical parameters to full characterization, from developing manufacturing test vectors on the bench to phase-locked at-speed testing in conjunction with production test systems, the HFS 9000 Data Time Generator simplifies the process while adding unmatched capabilities. You can, for example, create complex stimulus that are impossible with other systems. Download test vectors and timing parameters to the HFS 9000 to set up worst-case conditions and to stimulate each pin in isolation. Vary voltage levels, pulse widths and timing relationships independently for each channel. Mix high-speed and variable transition time modules to fit your logic family. And obtain channel counts unavailable in any other discrete instrument.

The Data Time Generator also provides a new dimension of assistance in characterizing pattern sensitivity. It provides the data stream while also creating the varying signal levels, timing relationships or signal characteristics required to detect pattern sensitivity across worst-case operating conditions.

Capabilities like these allow you to perform full characterizations on the first run, lowering your development costs and reducing your time to market.

Characteristics

Level Resolution – 0.01 V.

HIGH Level Accuracy – ±2% of level ±50 mV.

LOW Level Accuracy – ±2% of HIGH level ±2% of amplitude ±50 mV.

Output Aberrations (200ps after 50% pt) – Overshoot: +15% +20 mV, Undershoot: –10% –20 mV.

TIME BASE PERFORMANCE

Frequency Range – 50 kHz to 630 MHz.

Frequency Resolution – ≤0.1% of programmed value.

Frequency Accuracy – ±1% of programmed value.

RMS Jitter – 15 ps ±0.05% of interval.

PHASE LOCK IN Frequency Range – 6 MHz to 630 MHz.

PHASE LOCK IN Amplitude Range – 0.8 V to 1.0 Vp-p.

Output Frequency Range – any 2^n multiple or submultiple of PHASE LOCK IN frequency. Must remain inside the allowed frequency range for installed cards.

FRAME SYNC IN – Initiates a burst when using PHASE LOCK IN external frequency reference.

Continued on next page.

OUTPUT PERFORMANCE

	HFS 9DG1	HFS 9DG2	HFS 9PG1	HFS 9PG2
Outputs	4 differential	4 single-ended	2 differential	2 differential
Maximum HIGH level	+5.00 V	+5.50 V	+2.6 V	+5.5 V
Minimum LOW level	–2.50 V	–2.00 V	–2.00 V	–2.00 V
Max P-P amplitude	3.00 V	5.50 V	3.00 V	5.50 V
Min P-P amplitude	0.01 V (10 mV)	0.01 V (10 mV)	0.50 V	0.50 V
Output transition time (20% to 80%)	<250 p (≤1 Vp-p)	variable 800 ps to 6 ns	<200 ps (≤1 Vp-p)	variable 800 ps to 5 ns

HFS 9003 | HFS 9DG2
HFS 9009 | HFS 9PG1
HFS 9DG1 | HFS 9PG2

Programmable Stimulus System

Signal Sources

OUTPUT EDGE PLACEMENT PERFORMANCE

Channel Deskew Range – Minus 60 ns to 2.0 µs.

Channel Deskew Resolution – 1 ps (DG cards); 5 ps (PG cards).

DELAY Adjust Range – Zero to 20 µs.

DELAY Adjust Resolution – 1 ps (DG cards); 5 ps (PG cards).

DELAY Accuracy – 1% ±50 ps (HFS 9DG1 & 9DG2); 1% ±300 ps (HFS 9PG1 & 9PG2).

WIDTH Adjust Range – 0 to 65,536 times one period (DG cards); 0 to one period – 800 ps (PG cards).

WIDTH Adjust Resolution – 1 ps (DG cards); 5 ps (PG cards).

WIDTH Accuracy – HFS 9DG1: 1% of width ±50 ps; HFS 9DG2: 1% of width +50 ps –250 ps, HFS 9PG1 & HFS 9PG2: 1% of width ±300 ps.

TRIGGER INPUT PERFORMANCE

Input Resistance – 50 Ω.

Input Voltage Range – ±5 V maximum.

Programmable Threshold Range – –4.70 V to +4.70 V.

Programmable Threshold Resolution – 100 mV.

Programmable Threshold Accuracy – ±100 mV ±5% of level.

Minimum Input Pulse Width – 1 ns.

Input Rise/Fall Time Requirement – ≤10 ns

Sensitivity – ≤500 mV.

POWER REQUIREMENTS

Line Voltage Ranges – 90 VAC to 130 VAC rms, and 180 VAC to 250 VAC rms; range switched automatically for HFS 9003 (factory configured for HFS 9009).

Line Frequency – 48 Hz to 63 Hz.

Power Consumption –

	HFS 9003	HFS 9009
Maximum	540 W	900 W
Typical	400 W	750 W

ENVIRONMENTAL AND SAFETY

Temperature – Operating: 0° to +50°C; Non-operating: –40° to +75°C.

Humidity – Operating and non-operating: up to 95% relative humidity, up to +50°C.

Altitude, Shock Non-operating, Bench Handling – Meets MIL-T-28800C, Type III, Class 5.

Safety – Listed UL 1244, CSA Bulletin 556B September 1973; Tektronix self-certification to comply with IEC 348 recommendation.

PHYSICAL CHARACTERISTICS

HFS 9003	Cabinet		Rackmount	
Dimensions	**mm**	**in.**	**mm**	**in**
Width	414	16.3	483	19.0
Height	178	7.0	178	7.0
Depth	629	24.75	629	24.75
Weight*	**kg**	**lb.**	**kg**	**lb.**
Net	20.5	45.0	23.2	51.0
Shipping	27.3	60.0	30.0	66.0

** maximum configuration*

HFS 9009	Cabinet	
Dimensions	**mm**	**in.**
Width	426	16.75
Height	356	14.0
Depth	610	24.0
Weight	**kg**	**lb.**
Net	36.8	81.0
Shipping	45.5	100.0

HFS 9DG1, HFS 9DG2, HFS 9PG1, HFS PG2	Cabinet	
Dimensions	**mm**	**in.**
Width	51	2.0
Height	267	10.5
Depth	356	14.0
Weight	**kg**	**lb.**
Shipping	1.36	3.0

ORDERING INFORMATION

HFS 9003
Three-Slot Mainframe **$12,695**
Includes: User Reference Manual; Service Reference Manual; Power Cord; RS-232 Pigtail; SMA–BNC Adapter; Zip-Lock Pouch; two replacement fuses; and one 50Ω SMA Coaxial cable.
Opt. 1R – Rackmount ..... **+$295**

HFS 9009
Nine-Slot Mainframe **$19,995**
Includes: User Reference Manual; Service Reference Manual; Power Cord; RS-232 Pigtail; SMA–BNC Adapter; Zip-Lock Pouch; two replacement fuses; and one 50 Ω SMA Coaxial cable.

HFS 9DG1
Four differential data time outputs per card with <250 ps transition time, 630 MHz. **$11,000**
Includes: Installation Instructions and two Clock Cables.

HFS 9DG2
Four single-ended data time outputs per card with 800 ps to 6 ns variable transition time. **$7,900**
Includes: Installation INSTRUCTIONS and two Clock Cables.

HFS 9PG1
Two differential pulse outputs per card with <200 ps transition time, 630 MHz. **$9,000**
Includes: Installation instructions and two clock cables.

HFS 9PG2
Two differential pulse outputs per card with 800 ps to 5 ns variable transition time, 300 MHz. **$6,000**
Includes: Installation instructions and two clock cables.

INTERNATIONAL POWER PLUG OPTIONS
Opt. A1 – Universal Euro: 220 V, 50 Hz ..... **NC**
Opt. A2 – United Kingdom: 240 V, 50 Hz ..... **NC**
Opt. A3 – Australian: 240 V, 50 Hz ..... **NC**
Opt. A4 – North American: 240 V, 60 Hz ..... **NC**
Opt. A5 – Switzerland: 220 V, 50 Hz ..... **NC**
See Customer Information Section for additional description.

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

GPIB IEEE-488 — The HFS 9000 Series complies with IEEE Standard 488.1-1987, and with Tektronix Standard Codes and Formats.

Power Supplies

PS 503A
PS 501-1

PS 5010
PS 5004

Power Supplies

Design engineers require power supplies that are flexible enough to meet their needs and compact enough to allow a complete, custom-designed test system to fit neatly on a crowded workbench. To ensure versatility and convenience in your test system, the TM 5000/TM 500 power supplies can be rear-interfaced with other instruments to reduce front-panel clutter while providing capabilities not otherwise available.

Dual output supplies, such as the PS 5010, let you select independent series or parallel connections automatically, and, if you choose, will cause the output voltages of supplies connected in series to track together.

Critical specifications are voltage and current range, accuracy and resolution. Accuracy depends on source effect, load effect and temperature. Source effect deals with variations in line voltage. It may be specified as a percent of output or as a percent plus or minus a certain value. Load effect is the same as load regulation – the ability of the supply to maintain a constant voltage or current in the face of changes in loading. It is specified in terms of the maximum voltage change for given change in load current. Temperature effects are specified in terms of percents or parts per million/°C. Some manufacturers sum all of these into an overall accuracy figure. Noise and ripple provide another figure of merit, sometimes specified as PARD, for Periodic And Random Deviations. It is expressed in peak-to-peak millivolts, or milliamps.

Continued on next page.

POWER SUPPLIES SELECTION GUIDE

	PS 501-1	PS 503A	PS 5004	PS 5010
Number of Supplies	2	3	1	3
Maximum Voltages	0 to 20 V +5 V	–20 to +20 V, +5 V	0 to 20 V	+ and –32 V Logic (+4.5 to 5.5 V)
Maximum Amps	400 mA, 1A	1 A	305 mA	1.6 A, 3A
IEEE-488 Interface			•	•
Module Size	1 wide	1 wide	1 wide	2 wide

PS 5010

- Dual Floating Supplies 0 to 32 V, to 0.75 A (1.6 A to 15 V)
- Logic Supply 4.5 to 5.5 V, to 3 A
- 0.5% Accuracy
- Programmable Current Limits
- Three Independent Digital Displays
- Automatic Crossover
- Two Wide Size

PS 5004

- 0 to 20 V Floating Output
- 0.01% Accuracy
- 500 µV/0.1 mA Resolution
- Constant Voltage or Constant Current With Autocrossover
- Voltage- and/or Current-Monitoring Display
- Remote Sensing
- Single Width

PS 503A

- Independent Controls
- Dual Tracking Voltage Control
- 0 to +20 V and 0 to –20 V at 1 A
- Fixed Output 5 V at 1 A
- Remote Resistance Programming
- Single Wide Size

PS 501-1

- Precision Power Supply
- 0 to 20 V at 400 mA Floating Output
- Low Ripple and Noise
- Precision Regulation
- 3 1/2 Digit Ten-Turn Dial
- Fixed Output +5 V at 1 A

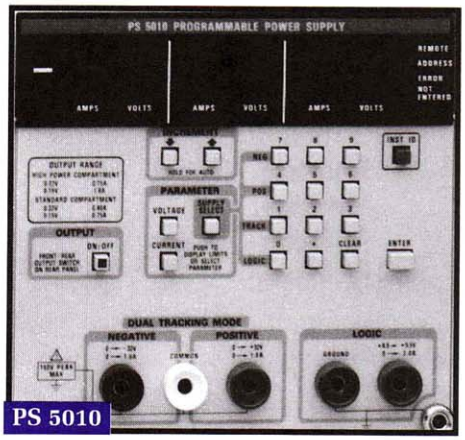
Power supplies that are flexible and compact to provide a complete custom-designed test system.

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

GPIB IEEE-488 — The PS 5004 complies with IEEE Standard 488.1-1987, and with Tektronix Standard Codes and Formats.

PS 5010
PS 501-1

Power Supplies



PS 5010

PS 501-1

PS 5010

The PS 5010 Programmable Triple Power Supply provides a complete and rapid high-performance solution for many system power-supply applications. Its three supplies provide the most commonly used voltages, and the three digital displays automatically indicate all six voltage- and current-limit parameters. Automatic crossover from voltage to current limit and a powerful set of GPIB status reporting messages allow the user to be constantly aware of the PS 5010's status.

The PS 5010's dual floating supply provides 0 to +32 V and 0 to –32 V, both with respect to a common front-panel terminal. Or 0 to 64 V across the terminals of both supplies together – with current up to 0.75 A throughout the total voltage range and 1.6 A below 15 V. The logic supply provides 4.5 to 5.5 V with respect to ground, with current to 3 A. The user can program the outputs on and off, and can lock out the front-panel controls with GPIB commands.

Characteristics

POSITIVE AND NEGATIVE FLOATING SUPPLIES CONSTANT VOLTAGE MODE

Voltage Range – 0 to +32 V, 0 to –32 V.

Voltage Accuracy – Overall (total effect) ±(0.5% + 20 mV), Source Effect (line regulation) ±(0.01% +2 mV).

PARD (Ripple and Noise) – 10 mVp-p, 20 Hz to 20 MHz.

Load Effect (load regulation) – 10 mV for a 1 A change in load current.

Temperature Coefficient (typical) – <(0.01% + 0.1mV)/°C.

Step Size Accuracy – 10 mV ±10 mV to 10.0 V 100 mV ±40 mV above 10.1 V.

CONSTANT CURRENT MODE

Range – 50 mA to 0.75 A (1.60 A at 15 V and below) in high-power compartment; 50 mA to 400 mA (0.75 A at 15 V and below) in two standard-power compartments.

Overall Accuracy – ±(5%+20 mA); Source Effect (line regulation) ±1 mA; Load Effect: ±10 mA; Output impedance is typically 5 kΩ shunted by 10 μF.

PARD (Ripple and Noise) – 10 mA p-p, 5 mA (RMS), 20 Hz to 20 MHz.

Resolution – 50 mA ±15 mA.

Change Response Time – 20 ms up or down.

Isolation (VDC + peak AC) – 150 V peak, front panel; 42 V peak, rear interface.

LOGIC SUPPLY

CONSTANT VOLTAGE MODE

Voltage Range – +4.5 to +5.5 V, ground referenced.

Overall Accuracy – ±50 mV.

Source Effect (line regulation) – 1 mV.

Load Effect (load regulation) – 10 mV for a 1 A change in load current.

Temperature Coefficient (typical) – <500 μV/°C.

Step Size Accuracy – 10 mV ±10 mV .

PARD (Ripple and Noise) – 10 mVp-p, 2 mV RMS, 20 Hz to 20 MHz.

CURRENT LIMIT

Range – 100 mA to 3.0 A (Foldback characteristic below 4.5 V, maximum short circuit current is <1.5 A).

Overall Accuracy – ±(5% + 20 mA).

Resolution – 100 mA ±30 mA.

Scaled Output – 10 mA =1 mV ±(2% + 2 mV) available at rear interface (not ground referenced).

Overvoltage Protection – SCR crowbar typically trips at 6 to 7 V.

GENERAL

Power Consumption – 250 VA maximum.

PS 501-1

The PS 501-1 supplies 0 to 20 V (floating) and adjustable current limiting to 400 mA, with constant-current operation above the limit setting. It features precise regulation and better than 2 mV resolution over its voltage range. A ten turn dial with mechanical digital readout provides an accurate display of the output voltage.

The floating supply is suited for powering discrete transistor circuitry, or acting as a bias or reference supply. Several PS 501-1s can be combined for applications involving complementary circuitry, linear integrated circuits, or any circuitry requiring cascaded DC levels.

A ground-referenced +5 V logic supply is also included and is capable of providing up to 1 A. The PS 501-1 is designed to operate in any compartment of a TM 500 or TM 5000 mainframe.

Characteristics

FLOATING SUPPLY

Range – 0 to 20 V DC.

Isolation – 350 V (DC + peak AC above ground).

Maximum Rated Current – 400 mA to +30°C derating to 300 mA at +50°C.

Current Limit – Adjustable from <40 mA to 400 mA.

Load Regulation – Within 1 mV for 400 mA change.

PARD (Ripple and Noise) – 0.5 mVp-p or less at 400 mA load, 20 Hz to 5 MHz.

Stability – Typically (0.1% +5mV) or less drift in 8 hours of constant line, load and temperature.

Indicators – Digital voltage readout to 20 V and current limit.

LOGIC SUPPLY

Range – 5 V nominal, ±0.25 V at 1 A.

Load Regulation – Within 100 mV with a 1 A load change.

Line Regulation – Within 50 mV for a 10% line voltage change.

PARD (Ripple and Noise) (1A) – 5 mVp-p or less, 20 Hz to 5 MHz.

Stability – Typically 30 mV or less drift in 8 hours.

Overload Protection – automatic current limiting and over-temperature shutdown.

Power Supplies

PS 5004

PS 5004

The single-width PS 5004 Precision Power Supply provides high-resolution voltages and currents necessary in the characterization of transistor, IC, and other semiconductor and hybrid circuits and in the operation of high-performance strain gauges and other transducer systems. Its 0 to 20 V output is covered with coarse and fine adjustments to provide rapid setability and 500 µV resolution without the necessity of changing ranges. Setability resolution over the GPIB is also 500 µV. The supply output is supplied at the rear interface and the front-panel terminals. Overall accuracy is ±0.01% ±2 mV.

The PS 5004 operates in either a constant-voltage or constant-current mode with autocrossover between the two. Front-panel annunciators indicate the mode at all times. The operating mode is also reported over the bus, and the PS 5004 can be programmed to assert SRQ when operating conditions cause it to change modes. The 4 1/2 digit display shows actual output voltage, selected current limit, or actual output current. The actual output voltage is shown even when the PS 5004 is operating in the current-limited or unregulated mode. Display resolution is 1 mV or 0.1 mA.

The buffered high-impedance sense terminals allow proper regulation of the supply with up to 3 Ω of resistance in either of the sense leads.

Characteristics

CONSTANT VOLTAGE MODE

Range – 0 V + 20.0000 V, 0.5 mV steps.

Overall Accuracy – (total effect) ±(0.01% +2mV) from +15°C to +30°C, derating to ±(0.035% + 3 mV) at 0°C and +50°C.

Source Effect (line regulation) – ≤0.5 mV.

Load Effect (load regulation) – ≤1 mV.

Temperature Coefficient (typical) – ≤(30 ppm +100 µV)/°C.

Step Size Accuracy – 500 µV, ±0.2 mV.

PARD (Ripple and Noise) – ≤1 mVp-p10 Hz to 1 MHz; ≤3 mVp-p, 10 Hz to 5 MHz.

CONSTANT CURRENT MODE

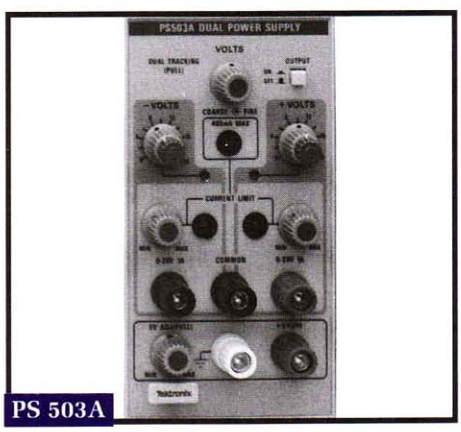
Range – 10 mA to 305 mA in 2.5 mA steps.

Overall Accuracy – ±(2% + 5 mA).

Isolation – 42 V (DC + peak AC).

GENERAL

Power Consumption – 35 VA maximum.



PS 503A

PS 503A

The PS 503A provides dual floating variable 20 V supplies, plus a fixed 5-V, 1-A supply. The PS 503A features superior tracking, overvoltage protection, and remote resistance programming of voltage. When operated in the high-power compartment of a TM 504, TM 506A, RTM 506, or TM 5006A mainframe, the PS 503A can provide up to 1 A from both of the 20 V supplies. A 0 to 40 V variable supply with up to 1 A of current can be configured by grounding one of the two outside terminals of the variable supplies. The two variable supplies can be set individually, then varied in a tracked mode with a single control. In addition, the plus and minus floating outputs can be programmed remotely, by either voltage programming or resistance programming via the rear interface.

Characteristics

±20 V FLOATING SUPPLIES

Range – 0 to +20 V, 0 to –20 V. 0 to 40 VDC across + and – terminals.

Stability – Typically 0.1% +5 mV or less drift in 8 hrs of constant line, load and temperature.

Isolation – 350 V (DC + peak AC).

Current Limit High-Power Compartment – <100 mA to 1 A.

Standard – <100 mA to 400 mA.

Line Regulation – ≤5 mV for a ±10% line voltage change.

Load Regulation – ≤3 mV for a 1 A load change.

Temperature Coefficient (typical) – <0.025%/°C.

Step Size Accuracy – 50 mV.

PARD (Ripple and Noise) – 3 mVp-p.

+5 V SUPPLY

Range – +4.75 to +5.25 VDC.

Current Limit – 1A.

Load Regulation – ≤50 mV for a ±10% line change.

Line Regulation – ≤100 mV for a 1 A load change.

PARD (Ripple and Noise) – 5 mVp-p.

ORDERING INFORMATION

PS 5010
Power Supply **$3,450**
Includes: Instruction Manual (070-3391-00); Instrument Interfacing Guide (070-4610-00); Reference Guide (070-3402-00).

PS 5004
Precision Power Supply **$2,150**
Includes: Instruction Manual (070-4442-00); Instrument Interfacing Guide (070-4789-00); Reference Guide (070-4596-00).

PS 503A
Power Supply **$995**
Includes: Instruction Manual (070-1834-01).

PS 501-1
Precision Power Supply **$995**
Includes: Instruction Manual.

WARRANTY-PLUS SERVICE OPTIONS

Opt. M7 – Calibration Service
PS 5010 ..... **+$170**
PS 5004 ..... **+$125**
PS 503A ..... **+$70**
PS 501-1 ..... **+$70**

Opt. M9 – Repair Protection
PS 5010 ..... **+$205**
PS 5004 ..... **+$145**
PS 503A ..... **+$90**
PS 501-1 ..... **+$90**

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

GPIB IEEE-488 — The PS 5010 and PS 5004 comply with IEEE Standard 488.1-1987, and with Tektronix Standard Codes and Formats.

Digital Multimeters
Measurement

CONTENTS

DIGITAL MULTIMETERS
General Information 320
DM5110 321
DM511 321
DM504A 324

Digital Multimeters

The Tektronix TM 5000/TM 500 Modular Digital Multimeter selection includes the single-wide, programmable DM 5110 as well as the manual DM 511, and the economical DM 504A. Now there exists a selection of performance and price to match most applications.

The DM 5110 represents the optimum choice for programmability, small size, performance, features, and competitive price. The DM 511 extends the capabilities over the DM 504A by offering dBV, dBm, and rear interfacing with a new easy-to-use front panel.

The TM 5000/TM 500 Digital Multimeters offer a compact solution to your measurement needs, without compromising performance. These instruments provide accuracy and flexibility on the laboratory bench, in field service, in maintenance applications, or in automatic system applications.

TRUE RMS MEASUREMENTS AND CREST FACTOR

Some meters read the average value of a time varying signal and use a constant scale factor of 1.11 to convert that to RMS. The calculation is based on the assumption that the input signal is a pure sine wave, in which case the average value is 0.637 times the peak and the RMS value is 0.707 times the peak (707/637 = 1.11).

This type of meter gives erroneous readings when the input is not a pure sine wave. For example, a half-wave rectified sine wave has an RMS value of 0.386 times the peak. However, an average-reading meter that uses the 1.11 scale factor will show a reading of 0.353 times the peak – more than 10% in error. All Tektronix DMMs provide true RMS readings.

The crest factor of a waveform is the ratio of its peak value to its RMS value. In a true RMS-reading DMM, the crest factor specifies the dynamic range of the instrument, or in more pragmatic terms, the square-wave duty cycle for which it will return accurate measurements. For example, the Tektronix TM 500 and TM 5000 DMMs have a crest factor of 3, which means that they can accurately measure rectangular waveforms with duty cycles as low as 10 percent.

NMRR AND CMRR

DMM specs often list both normal mode rejection ratio (NMRR) and common mode rejection ratio (CMRR). Generally, NMRR applies to DC measurements. It is a measure of the instrument's ability to reject line noise on a DC signal. DMMs achieve NMRR by taking measurements over time periods that cover an integral number of power line cycles. For example, some TM 500 and TM 5000 products use a measurement period of 200 ms, which covers both 50 and 60 Hz (5 cycles of 50 Hz or 6 cycles of 60 Hz.) High end instruments often allow you to select measurement speed, but you have to be aware that when you select
certain speeds, you may be sacrificing some NMRR.

DIGITAL MULTIMETER SELECTION GUIDE

	DM 504A	DM 5110/DM 511
Number of Digits	4 1/2	4 1/2
DC Volts Ranges	200 mV to 1000 V	200 mV to 1000 V
DC Volts Best Accuracy	±0.05%	±0.05%
DC Volts Best Resolution	10 µV	10 µV
AC Volts Ranges	200 mV to 500 V	200 mV to 500 V
AC Volts Best Accuracy	±0.6%	±0.3%
AC Volts Best Resolution	10 µV	10 µV
AC or DC Current Ranges	200 µA to 2 A	200 µA to 2 A
dB Ranges	N/A	+54 dB to –50 dB
Resistance (HI-LO) Ranges	200 Ω to 20 MΩ	200 Ω to 20 MΩ
Temperature Measurement Range	–62 to +230°C	–62 to +230°C
True RMS	•	•
Autorange	•	•
IEEE Standard 488 Interface	No	(DM 5110 Only)
Module Size	1 wide	1 wide
Mainframe Compatibility TM 5000	TM 500 or TM 5000 for DM 5110	TM 500/5000 for DM 511

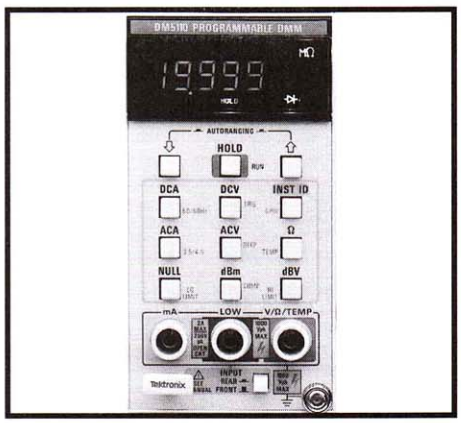
CMRR also describes the ability of the instrument to reject interfering signals, but only under differential input conditions. That is, it applies when a common interfering signal is present on both lines of a balanced, push-pull signal applied to the DMM's dual inputs.

However, in evaluating CMRR, it is important to remember that DMMs do not have true differential amplifiers. The capacitive loading in the low input is significantly greater than in the high. As a result, CMRR is frequency-sensitive. One further point to note is that some manufacturer's CMRR specifications include NMRR. The resulting specification is only valid at the power line frequency.

dB MEASUREMENTS AND NULL

Some instruments allow you to make relative measurements by storing an offset NULL value. On Tektronix instruments that offer this feature, you press the NULL button (or invoke the function via GPIB) to store the currently displayed value. One example of the use of this feature is in resistance measurements, compensating for the resistance of the test leads. By invoking NULL with the probe tips shorted together and the instrument at its lowest range, the test lead resistance will be recorded and automatically subtracted from subsequent measurements.

In AC amplifiers, it is often desirable to measure gain, attenuation, and filter stages in terms of decibels, rather than in terms of voltage or current gain. This is because decibels are additive. That is, when an input signal level of –30 dBV comes out of a 10 dB gain stage, it has a level of –20 dBV. Many DMMs provide dBV (decibels referred to 1 Volt) and dBm (decibels referred to 1 mW across a 600 Ω load, which happens to be 0.775 Vrms).
If the instrument has a NULL feature, decibel measurements can be made relative to any signal level by selecting either dBm or dBV invoking the NULL function manually or over the GPIB.



DM 5110/511

The DM 5110/DM 511 offers exceptional functionality and the highest performance available in a low-cost, single-width plug-in module.

The DM 5110 is fully programmable over the IEEE-488 interface, while the DM 511 is designed for manual operation only; the units are otherwise identical. The DM 5110 occupies one slot in any TM 5000 Mainframe, and the DM 511 can be operated in either a TM 500 or TM 5000 Mainframe.

A FULL RANGE OF FUNCTIONS

Both units give you a choice of either autoranging or manual operation for all standard functions – voltage, current or resistance measurements. Also included are true RMS AC measurements and dB calculations plus features not normally found in a low-cost DMM.

The normal resolution mode of 4 1/2 digits, together with a minimum range of 200 mV, allows voltages as small as 0 μV to be resolved; a 3 1/2 digit mode provides for faster test throughput. Basic accuracy is ±0.05%. And 50 Hz or 60 Hz mode selection provides normal-mode-rejection ratio improvement.

FRONT-PANEL CONVENIENCE

Operation of the DM 5110/DM 511 is via twelve front-panel "soft keys" which are used to select function and range.

When programming the DM 5110, they are also used to set the GPIB address and termination.

Continued on next page.

DM 5110/DM 511

- 4 1/2 Digit Autoranging
- Fast (3 1/2 Digit) Mode
- AC/DC Voltage, AC/DC Current, Resistance and (optional) Temperature Measurement
- AC dBm and dBV Calculations
- True RMS AC Functions
- Null and Hold Modes
- Hi/Lo/Pass Limit Testing and Compare Mode with Beeper
- Standard IEEE-488 Interface (DM 5110 only)
- Front and Rear Interfacing
- Single Wide Size

The DM 5110/ DM 511 offers exceptional functionality and the highest performance available in a low-cost, single-width plug-in module.

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

DM 5110
DM 511

Digital Multimeters
Measurement

In addition to 7-segment readout and function/range annunciators, front-panel LEDs are included with both units as NULL, HOLD and AUTO mode indicators. The DM 5110 offers LEDs for two additional modes: REM (indicating remote operation) and ADDR (indicating the instrument is being addressed to talk or listen). The DM 5110 also includes a front-panel ID button to request a display of a GPIB address and termination, and to generate an SRQ under certain circumstances.

A manually-operated front-panel switch is used to select front or rear connection to Volts and Ohms measurement modes. The switch is not operable over the GPIB, but its status can be queried and monitored remotely. (Caution – maximum input voltage on the rear connector pins is 60 VDC ±pk AC.)

NULL mode operates with all functions and allows you to apply a display offset to make a relative measurement.

HOLD mode stops the instrument from measuring and displays the last measurement made. The HOLD key toggles the instrument between HOLD and RUN modes.

The TRIG key lets you make a single measurement and then automatically return to HOLD.

COMPARE mode makes it possible to compare measurements against user-defined HI and LO limits. A beeper indicates when a measurement is out of limits.

Temperature measurements are made using an optional Tektronix P6602 Temperature Probe, or an equivalent platinum resistance probe. DM 5110/DM 511 will measure temperatures from –62° to 240°C.

Characteristics

DC VOLTS

Accuracy – (4 1/2 digits, auto or manual ranging, front or rear input):

% of Reading + % of Full Scale

Range	18°–28°C	0°–18°C 28°–50°C
200 mV	±(0.05% + 0.015%)	±(0.15% + 0.04%)
2V	±(0.015% + 0.01%)	±(0.1% +0.02%)
20 V	±(0.05% + 0.015%)	±(0.15% + 0.025%)
200 V	±(0.05% + 0.01%)	±(0.1% + 0.02%)
1000 V	±(0.05% + 0.02 %)	±(0.1% + 0.02%)

CMRR (with 1 kΩ unbalance) – ≥100 dB @ DC, ≥80 dB @ 50/60 Hz.

NMRR – ≥50 dB @ 50/60 Hz (±0.2 Hz).

Max. Resolution – 10 μV.

Step Response Time – <50 msec to 0.05% of step.

Input Resistance – 10 MΩ ±0.5%.

Max. Input Voltage – Front panel, LOW to GND and V/Ω/Temp to LOW or GND: 1000 V pk; Rear connector, HI to LO and HI or LO to Chassis: 60 VDC + pk AC.

TRUE RMS AC VOLTS

Accuracy – (4 1/2 digits, auto or manual ranging, front or rear input, 200 mV to 500 V range):

% of Reading + % of Full Scale

Input Frequency	18°–28°C	0°–18°C, 28°–50°C
20 Hz to 100 Hz: *1	±(0.8% +0.05%)	±(1.1% +0.075%)
100 Hz to 10 kHz:*1	±(0.3% +0.05%)	±(0.6% +0.075%)
10 kHz to 20 kHz:*2	±(0.6% +0.05 %)	±(0.9% +0.05%)
20 kHz to 50 kHz:*3	±(1.0% +0.05%)	±(1.3% +0.075%)

**1 For inputs >200 counts, 200 mV to 200 V ranges; >50 counts, 500 V range.*
**2 For inputs >500 counts, 200 mV to 200 V ranges; >250 counts, 500 V range.*
**3 For inputs >2000 counts, 200 mV to 200 V ranges; >500 counts, 500 V range.*

CMRR (with 1 kΩ unbalance) – ≥60 dB @ 50/60 Hz.

Max. Resolution – 10 μV.

Step Response Time – ≤0.3 sec to 1% of step.

Input Impedance – 2 MΩ ±0.1%, paralleled by <50 pF.

Max. Input Voltage – Front panel, V/Ω/Temp to LOW: 500 V rms or 600 VDC. Front panel, V/Ω/Temp or LOW to GND: 1000 V pk; Rear connector, HI to LO and HI or LO to Chassis: 60 VDC + pk AC.

Crest Factor – 3:1 for 0.1% additional error.

dB (TRUE RMS AC VOLTAGE)

Accuracy – (4 1/2 digits, auto or manual ranging, front or rear input):

Range, dBV	Range, dBm	18° –28°C	0°–18°C 28°–50°C	Frequency
–34 to +54	–32 to +56	±0.3 dB	±0.4 dB	20 Hz – 20 kHz
–54 to –34	–52 to –32	±0.6 dB	±0.8 dB	20 Hz – 10 kHz
–60 to –54	–58 to –52	±1.0 dB	±1.5 dB	20 Hz – 10 kHz

Digital Multimeters
Measurement

DM 5110
DM 511

Max. Resolution – 0.01 dB.

Response Time – <0.3 sec to 1% of step.

Input Impedance – 2 MΩ ±0.1%, paralleled by <50 pF.

Max. Input Voltage – Front panel, V/Ω/Temp to LOW: 500 V rms or 600 VDC. V/Ω/Temp or LOW to GND: 1000 V pk; Rear connector, HI to LO and HI or LO to Chassis: 60 VDC + pk AC.

DC AMPS

Accuracy – (4 1/2 digits, auto or manual ranging, front panel only):

% of Reading + % of Full Scale

Range	18°–28°C	0°–18°C, 28°–50°C
200 µA, 2 mA, 20 mA	±(0.1%	±(0.3%
200 mA, 2000 mA	+0.01%)	+0.025%)

Response Time – <50 ms to 0.05% of step.

Input Resistance –

Range	≈ Resistance
200 µA	1.0 kΩ
2 mA	100 Ω
20 mA	10.2 Ω
200 mA	1.2 Ω
2000 mA	.26 Ω

Max. Open-Circuit Input Voltage – 250 V pk, mA to LOW.

Max. Input Current – 2 A any range.

Max. Floating Voltage – 1000 V pk, mA or LOW inputs to GND.

Max. Resolution – 10 nA.

AC AMPS

Accuracy – (4 1/2 digits, auto or manual ranging, front panel only, all ranges):

% of Reading + % of Full Scale

Frequency	18°–28°C	0°–18°C 28°–50°C
20 Hz to 100 Hz (input >200 counts)	±(0.8% +0.05%)	±(1.1% +0.075%)
100 Hz to 10 kHz (input >200 counts)	±(0.3% +0.05%)	±(0.6% +0.075%)

OHMS

Accuracy – (4 1/2 digits, auto or manual ranging, front or rear input):

% of Reading + % of Full Scale

Range	18°–28°C	0°–18°C 28°–50°C	Source Current	Vmax
200 Ω	±(0.05% + 0.02%)	±(0.25% + 0.04%)	1.0 mA	0.2 V
2 kΩ	±(0.05% + 0.01%)	±(0.25% + 0.03%)	1.0 mA	2.0 V
20 kΩ	±(0.05% + 0.02%)	±(0.25% + 0.04%)	10 µA	0.2 V
200 kΩ	±(0.05% + 0.01%)	±(0.25% + 0.03%)	10 µA	2.0 V
2 MΩ	±(0.1% + 0.02%)	±(1.0% + 0.04%)	0.1 µA	0.2 V
20 MΩ	±(0.1% + 0.01%)	±(1.0% + 0.03%)	0.1 µA	2.0 V

Crest Factor – 3:1 for 0.1% additional error.

Response Time – <0.3 sec to 1% of step.

Input Resistance –

Range	≈ Resistance
200 µA	1.0 kΩ
2 mA	100 Ω
20 mA	10.2 Ω
200 mA	1.2 Ω
2000 mA	.4 Ω

Max. Open-Circuit Input Voltage – 250 V pk, mA to LOW.

Max. Input Current – 2 A any range.

Max. Floating Voltage – 1000 V pk, mA or LOW inputs to GND.

Response Time – <0.2 sec, 200 Ω to 200 MΩ ranges; <2 sec, 20 MΩ range.

Max. Input Voltage, All Ranges – Front Panel: 300 V pk. Rear Connector: 60 V pk.

Max. Resolution – 10 MΩ.

Max. Open-Circuit Voltage – <11 V.

TEMPERATURE

Accuracy – (4 1/2 digits, front panel, input only):

Measurement Range	18°–28°C	0°–18°C 28°–50°C	Probe Status
–62° to +150°C	±0.6°C	±1.5°C	Instrumen
+150° to +240°C	±1.6°C	±2.5°C	calibrated to probe
–62° to +150°C	±3.5°C	±4.5°C	Any
+50° to +240°C	±6.0°C	±7.0°C	probe

MISCELLANEOUS

Reading Rate – 4.5 Digits (NORMAL): >3/s; 3.5 Digits (FAST): >25/s.

Power Consumption – <10 W.

Over-range Indication – Flashing display.

Warm-up Time – 30 minutes (60 minutes after storage in high humidity environment).

PHYSICAL CHARACTERISTICS

Temperature – Operating: –0° to +50°C; Non-Operating: –55° to +75°C.

ORDERING INFORMATION

DM 5110
Programmable Autoranging Digital Multimeter **$895**
Includes: Operators Instruction Manual (070-7478-00); Instrument Interfacing Guide (070-7560-00); Reference Guide (070-7559-00); Meter Leads, Set (196-3212-00).

DM 511
Autoranging Digital Multimeter. **$795**
Includes: Operators Instruction Manual (070-7478-00); Instrument Interfacing Guide (070-7560-00); Reference Guide (070-7559-00); Meter Leads, Set (196-3212-00).

Opt. 02 – Adds a Tektronix P6602 Temperature Probe that has been calibrated with the DM 5110/DM 511 ..... **+$260**

Service Manual – Order 070-7479-00 ..... **$55**

WARRANTY-PLUS SERVICE OPTIONS

Opt. M7 – Calibration Service DM 5110 ..... **+$170**

Opt. M9 – Repair Protection DM 5110 ..... **+$200**

PROBES

Temperature – Order P6602 ..... **$335**

High Voltage – Order 010-0277-00 ..... **$255**

RF – Order P6420 ..... **$200**

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

GPIB IEEE-488 — The DM 5110 complies with IEEE Standard 488.1-1987, and with Tektronix Standard Codes and Formats.

DM 504A

Digital Multimeter

Our value priced 4 1/2 digit, manual, modular, digital multimeter.

DM 504A

- 4 1/2 Digit Autoranging
- True RMS AC Functions
- Five Manually Selectable Voltage, Current and Resistance Ranges
- DC Volts, AC Volts, DC mAmps, AC mAmps, Ohms and Temperature Functions
- Diode Test and Audible Continuity (Beeper) Modes
- Single Wide Size

DM 504A

DM 504A

The DM 504A Autoranging Digital Multimeter extends the functionality of the Tektronix TM 500 line of modular, digital multimeters with true RMS measurements, a "beeper" mode for indication of short circuits, and diode testing capability. The DM 504A also provides standard AC/DC voltage and current, and resistance measurements, and will operate in any compartment of a TM 500 or TM 5000 power module.

All measurement ranges, except temperature, diode measurements, and audible continuity (beeper), can be automatically or manually selected.

An audible "beeper" mode is provided for testing continuity. A beeper symbol is displayed when the 200 Ω mode is selected, indicating that a beeper will sound a continuous tone for measurements less than 10 Ω. In the 2 MΩ, 200 kΩ and 2 kΩ ranges a diode measurement indicator will illuminate on the display, indicating that V max is adequate for diode testing.

Characteristics

DC VOLTS

Ranges – 200 mV, 2 V, 20 V, 200 V, 1000 V.

Accuracy*1 – For automatic or manual ranging 18 to 28°C: All ranges ±(0.05% of reading ±0.02% of full scale).

CMMR – (Within 1 kΩ unbalanced) 100 dB at DC, 80 dB at 50/60 Hz.

NMMR – 60 dB at 50/60 Hz (±0.2 Hz).

Max. Resolution – 10 μV.

Step Response Time – <1 s.

Input Resistance – 10 MΩ ±0.5%.

Max. Input Voltage – 1000 V peak.

TRUE RMS AC VOLTS

Ranges – 200 mV, 2 V, 20 V, 200 V, 500 V.

Accuracy*1 – For automatic or manual ranging –18° to 28°C: 200 mV to 200 V range, 30 Hz to 20 kHz. For input signals >10% to 100% of full range, accuracy is ±(0.6% of reading + 0.06% of full scale). For signals >25%, and 10 kHz to 20 kHz add 4.1% additional error. 500 V range, 60 Hz to 20 kHz. For input signals >100 V to 500 V RMS, accuracy is ±(0.6% of reading + 0.1% of full scale). 40 Hz to 60 Hz ±(1% of reading + 0.1% of full scale).

CMMR – (With 1 kΩ unbalance) – 60 dB at 50 or 60 Hz.

Max. Resolution – 10 μV.

Response Time – <2 s.

Input Impedance – 10 MΩ ±0.5% paralleled by <100 pF.

Max. Input Voltage – Volts/Ohms/TEMP to LOW: 500 V RMS or 600 VDC, VOLTS/ohms/TEMP to GND: 1000 V peak. LOW to GND: 1000 V peak.

Crest Factor – 5 at full scale on all ranges except 500 V (500 V = 2).

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

Digital Multimeter

RESISTANCE

Accuracy*1 – For automatic or manual ranging 18° to 28°C.

Range	% of Reading + % Full Scale	Source	Vmax Full-Scale
200 Ω (beeper)	±(0.05% + 0.05%)	1.0 mA	0.2 V
200 Ω	±(0.05% + 0.02%)	1.0 mA	0.2 V
2 kΩ	±(0.05% + 0.01%)	1.0 mA	2.0 V
20 kΩ	±(0.05% + 0.02%)	10 µA	0.2 V
200 kΩ	±(0.05% + 0.01%)	10 µA	2.0 V
2 MΩ	±(0.1% + 0.02%)	0.1 µA	0.2 V
20 MΩ	±(0.1% + 0.01%)	0.1 µA	2.0 V

**1 Valid for six months or 1000 hours, whichever comes first.*

DC CURRENT/AC CURRENT

Ranges – 200 µA, 2 mA, 20 mA, 200 mA, 2 A.

Accuracy*1 – DC current: for automatic or manual ranging 18° to 28°C. ±(0.1% of reading + 0.01% of full scale). AC Current: for automatic or manual ranging 18° to 28°C. ±(0.6% of reading +0.6% of full scale).

Response Time – DC Current: <1 s. AC Current: <2 s.

Input Resistance –

Range	Resistances	
	DC current	AC current
200 µA	1.0 k Ω	1.0 k Ω
2 mA	100.0 Ω	100 Ω
20 mA	10.2 Ω	10.2 Ω
200 mA	1.2 Ω	1.2 Ω
2000 mA	0.28 Ω	0.4 Ω

Max. Open-Circuit Input Voltage (mA to LOW) – 250 V peak.

Max. Input Current – 2 A any range.

Max. Floating Voltage – mA to GND, 1000 V peak; LOW to GND, 1000 V peak.

Max. Resolution – 10 nA.

Max. Floating Voltage – mA to GND, 1000 V peak, LOW to GND, 1000 V peak.

TEMPERATURE

Range – minus 62° to +230°C.

Accuracy – Using Tektronix P6602 Temperature Probe: 18° to 28°C ambient. Probe calibrated to instrument (probe/DMM calibration performed at 0°C). ±0.6°C from minus 62° to 150°C. ±1.6°C from 150° to 230°C. Any probe: ±3.5°C from minus 62° to 150°C. ±1.6°C from 150° to 230°C.

OTHER CHARACTERISTICS

Reading Rate – >2.0 times/s.

Over-range Indication – Flashing display.

Warm-up Time – 30 minutes (50 minutes after storage in high humidity environment).

Dimensions – Single TM 500/TM 5000 compartment.

Weight – 0.93 kg (2.04 lb).

**1 Valid for six months or 1000 hours, whichever occurs first.*

ORDERING INFORMATION

DM 504A

Digital Multimeter **$645**

Includes: Instruction Manual (070-6945-00); one set of test leads.

Opt. 02 – Adds P6602 ..... **+$260**

Temperature Probe calibrated for use with DM 504A.

WARRANTY-PLUS SERVICE OPTIONS

Opt. M7 – Calibration Service ..... **+$70**

Opt. M9 – Repair Protection ..... **+$125**

ADDITIONAL ACCESSORIES

Service Manual – 070-7135-00 ..... **$28**

PROBES

Temperature – Order P6602 ..... **$335**

High Voltage – Order 010-0277-00 ..... **$255**

RF – Order P6420 ..... **$200**

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

Digital Counters
Measurement

CONTENTS

DIGITAL COUNTERS

General Information....326
DC 5010....328
DC 510....328
DC 5009....330
DC 509....330
DC 504A....332
DP 501....332
DC 503A....334

Digital Counter/Timers

The TM 500/TM 5000 family of modular instruments includes six digital counter/timers, which provide a wide variety of price/performance features. The DP 501 digital prescaler extends the frequency measurement capability of all counters to 1.3 GHz.

The 350 MHz DC 5010/DC 510, and the 135 MHz DC 5009/DC 509, are universal counter/timers that feature reciprocal frequency measurements and an especially wide range of other measurement functions, plus features such as autotrigger, auto-averaging, arming, probe compensation, and more. The DC 5010 and DC 5009 are GPIB programmable; this capability can be added to the DC 510 and DC 509 as field modifications. In performance other than programmability, the DC 510 and DC 5010 are equal, as are the DC 5009 and DC 509.

For versatility in counting, the DC 503A 125 MHz Universal Counter/Timer features eight measurement functions, including period, width, and time-interval averaging. Both input channels have the full 0 to 125 MHz frequency range, 20 mV RMS sensitivity, and separate controls for input coupling, attenuation, trigger level, and trigger slope. The 10 MHz clock provides 100 ns resolution of single-shot time interval measurements, and 10 ps resolution with averaging.

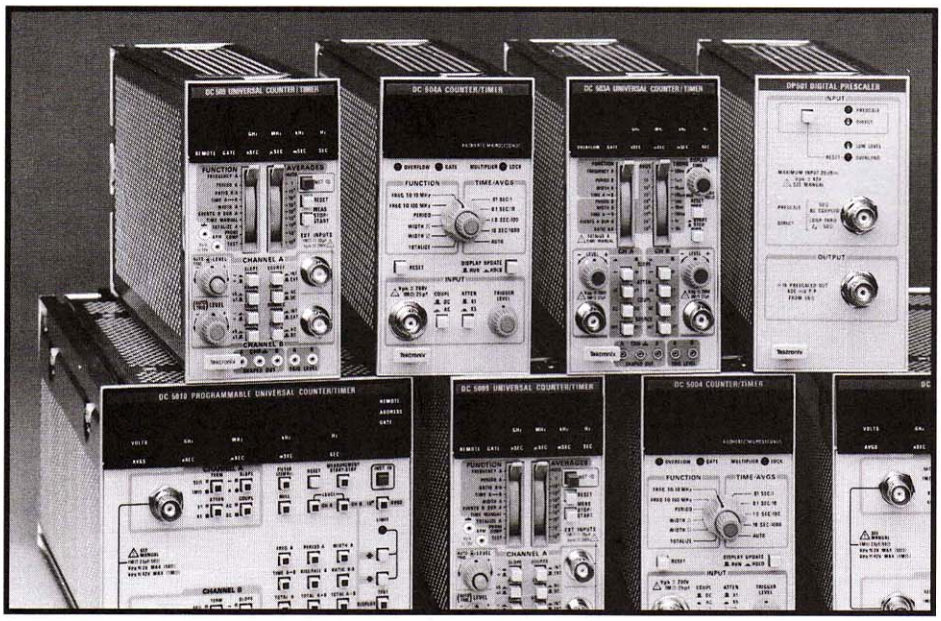
The 100 MHz DC 504A features autorange, period and width averaging, an internal 100X multiplier to provide high resolution of low frequency signals.

APPLICATIONS

Tektronix TM 5000 and TM 500 counter/timers are primarily used in environmental and production testing and on the engineering benchtop. Sometimes, they are used in field service, packaged with other Tektronix modular instruments in configurations aimed at specific testing applications.

Frequency and period measurements are straight forward, and applications abound, from RF design to manufacturing test of digital systems. On the other hand, there is a wide variety of timing measurements . . . not every counter/timer can make them all. The most basic timing measurements are pulse width, with which you can measure not only whole pulses, but (by adjusting trigger level) the width of aberrations, such as ringing. Some instruments will automatically measure risetimes and falltimes.

Using both input channels, you can make the time A ≥B measurement, which is used for propagation delays. You can also measure the number of events occurring on channel B during an interval on channel A.



Digital Counters
Measurement

Tektronix modular counter/timers can totalize events on both channels and present the results as a sum, a difference, or a ratio. This can be invaluable in troubleshooting intermittent bugs in digital circuits in which a certain number of input events are supposed to produce a certain number of output events. For example, you could measure the ratio of input pulses to output pulses in a decade counter while stressing the circuit in various ways. If the ratio varied from 10 at any point, you would have localized the fault. Shaped output is a relatively uncommon feature that is provided on Tektronix counter/timers. Essentially, it is a representation of the instrument's trigger signal. Applied to one channel of an oscilloscope, with the input signal applied to another channel, it can be used to verify that the counter/timer is triggering on the correct portion of the input waveform.

ACCURACY AND RESOLUTION

Accuracy describes how closely a measurement agrees with a standard. It depends on time base and trigger slew and jitter errors. To minimize time base errors, all Tektronix TM 500 and TM 5000 modular counter/timers use an oven-controlled-crystal time base.

In the case of the DC 5010/DC 510, temperature stability is a flat $\pm 2 \times 10^{-7}$, regardless of temperature, up to an ambient of 50°C. Ideally, resolution would be plus or minus one times the least significant digit (LSD). However, resolution is also tied to the uncertainty of the length of the last event counted. That's why single-shot resolution is less than resolution with averaging. For example, on the DC 5010/DC 510, single event resolution is 3.125 ns, but resolution with averaging is 1 ps.

DIGITAL COUNTER SELECTION GUIDE

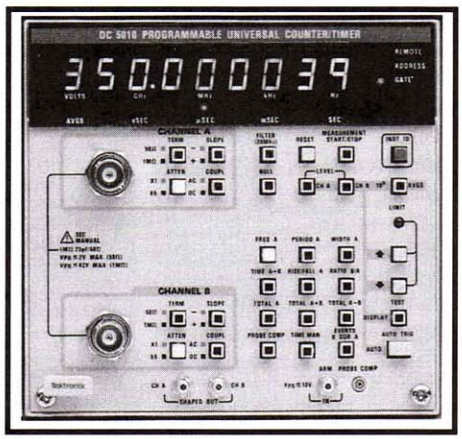
	DC 510/DC 5010	DC 509/DC 5009	DC 503A	DC 504A
Frequency Range	350 MHz	135 MHz	125 MHz	100 MHz
With DP 501	1.3 GHz	1.3 GHz	1.3 GHz	1.3 GHz
Number of Digits	9	8	8	6
Ratio Architecture	•	•		
Period Averaging	•	•	•	•
Width Averaging (Single Input)	•	•	•	•
Time Interval Averaging	•	•	•	•
Autotrigger	•	•		
Gated Events Averaging	B during A	B during A	A during B	
Ratio Averaging	•	•	•	
Other	High stability time base, trigger level and shaped outputs, self-test, phase modulated clock, probe compensation, time manual, totalize.	High stability time base, trigger level and shaped outputs, self-test, phase modulated clock, probe compensation, time manual, totalize.	High stability time base, trigger level and shaped outputs, time manual, totalize.	Autorange, 100X resolution multiplier
IEEE Standard 488.1-1987	DC 5010 only	DC 5009 only		
Mainframe Compatibility	DC 510 TM 500/TM 5000 DC 5010 TM 5000 only	DC 509 TM 500/TM 5000 DC 5009 TM 5000 only	TM 500/ TM 5000	TM 500/ TM 5000
Module Size	2 wide	1 wide	1 wide	1 wide

Universal Counter/Timers

High resolution measurement of low frequency signals much faster than conventional counting techniques.

DC 5010 PROGRAMMABLE/ DC 510

- 350 MHz both A and B Channels
- 3.125 ns Single-Shot Resolution
- 9-Digit Display
- 1 ps Resolution, with Averaging
- Reciprocal Frequency Measurement; Period; Width; Time AB; Events B During A; Totalize A, AB; Ratio; Rise/Fall; Time Manual; Arming; Null
- Auto or Selected Averaging to 10^8 in All Modes
- Duty-Cycle Independent Autotrigger
- DVM Mode for Displaying Trigger-Level Setting
- Shaped A and B Channel Outputs
- Hysteresis Compensation
- Probe Compensation
- High Stability Oven Time Base
- Two Wide Size



DC 5010/DC 510

The DC 5010/DC 510 Universal Counter/Timers feature reciprocal frequency to 350 MHz, period, ratio, events B during A measurements, and time A to B. The powerful reciprocal technique provides high resolution of low frequency signals much faster than conventional counting techniques. The pseudo-random, phase-modulated time base provides increased accuracy by eliminating synchronous errors in the time interval and width averaging modes.

Auto trigger senses the applied signal and sets trigger levels to the optimum points. In the DC 5010, trigger levels, the minimum and maximum signal voltage levels, and the trigger voltage are available over the GPIB, and can be viewed on the 9-digit display.

Other features include an arming input that allows measurement of selected inputs from complex waveforms, hysteresis compensation and probe compensation for attenuator type probes.

Characteristics

CHANNEL A AND CHANNEL B INPUT

Frequency Range – 50 Ω termination: >0 to ≥350 MHz DC coupled. 100 kHz to ≥350 MHz AC coupled. 1 MΩ termination >0 to ≥300 MHz DC coupled. 16 Hz to ≥300 MHz AC coupled.

Sensitivity – 50 Ω termination DC: ≤25 mV RMS sinewave to 350 MHz ≤70 mVp-p pulse 1 MΩ termination. DC/AC ≤25 mV RMS to 200 MHz. 42 mV RMS to 300 MHz.

Attenuation Selectable – 1X, 5X.

Impedance – 1 MΩ paralleled by 23 pf ±2.2 pF (10%) or 50 Ω ±3% DC.

Dynamic Range – 70 mVp-p to 4 Vp-p (x attenuation).

Trigger Level Range – ≥+ 2 V to ≤– 2 V with 4 mV resolution (X1). ≤±10 V to ≤-10 V with 20 mV resolution (X5).

Trigger Level Accuracy – ±1% of F.S. trigger level range, plus ±2% of reading for a DC input V, ±40 mV X Attenuator.

Autotrigger Frequency Range – 10 Hz to ≤350 MHz.

Independent Controls – Slope, Attenuation 1X/5X, Couple AC/DC, Impedance 1 MΩ/50 Ω.

Maximum Input Voltage (1 MΩ input impedance) – 1X: ±42 V (DC + peak AC) to 200 kHz; ±2 V (DC + peak AC) 2 to 250 MHz. 5X: ±42 V (DC + peak AC) to 1 MHz; ±10 V (DC + peak AC) 1 to 250 MHz. In 50 Ω Input Impedance: Signals >±2 V x attenuator will cause input protection circuitry to switch input to 1 MΩ.

Shaped Out – Shaped replica of signal being measured aids proper triggering on complex waveforms (≤100 mV typically to 350 MHz into 50 Ω load).

Arming Input – Permits measurements of complex waveforms. A TTL high allows averaging of selected events within a measurement.

FREQUENCY A

Range – ≤36 μHz to ≥350 MHz.

Resolution –

$$\pm LSD \pm 1.4\left(\frac{\text{A Trigger Jitter Error}}{N}\right) \times (\text{Frequency A})^2$$

Accuracy –
Resolution ±(Time Base Error x Frequency A)

PERIOD A

Range – 3.125 ns to 7.6 hrs.

Resolution –

$$\pm LSD \pm \frac{1.4 \times \text{A Trigger Jitter Error}}{N}$$

Accuracy – (±Time Base Error x Period A)

RATIO B/A

Range – 10^{-8} to 10^{9} (Frequency Range: ≤36 μHz to ≥350 MHz). (10^{-11} to 10^{12} w/o decimal point)

Resolution –

$$\pm LSD \pm \frac{1.4 \times \text{B Trigger Jitter Error} \times \text{Frequency B}}{N}$$

Accuracy – Same as Resolution.

TIME A → B

Range – 2.0 ns to 7.6 hrs.

Minimum Dead Time – 12.5 ns (stop to start).

Resolution –

$$\pm LSD + \frac{1}{\sqrt{N}} \times \left(\frac{\pm \text{ Trig. Jit. Error CH A start edge}}{\pm \text{Trig. Jit. Ettor CH A stop edge}}\right)$$

Continued on next page.

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

GPIB IEEE-488 — The DC 5010 complies with IEEE Standard 488.1-1987, and with Tektronix Standard Codes and Formats.

Universal Counter/Timers

DC 5010
DC 510

Accuracy – Resolution ±(Time Base Error xTI) ±Channel Delay Mismatch + B Trigger slew error –A Trigger slew error.

Channel Delay Mismatch – <2 ns between front panel inputs, without null.

EVENTS B DURING A
Range – 10^{-8} to 10^{9}.

Maximum B Frequency – ≥350 MHz.

Maximum A Frequency – ≥80 MHz.

Maximum A Pulse Width – ≤4.0 ns.

Minimum Time Between A Pulses – ≤8.5 ns.

Minimum Dead Time Between Pulses – ≤8.5 ns.

Resolution –

$$\pm LSD + \frac{\text{Freq. B}}{\sqrt{N}}$$

$$\times \left(\frac{\pm \text{ Trig. Jit. Error CH A start edge}}{\pm \text{Trig. Jit. Ettor CH A stop edge}} \right)$$

Accuracy – Resolution Frequency B (Stop Slew Rate Error-Start Slew Rate Error) + Frequency Bx (5 x 2 ns).

WIDTH A
Range – ≤4 ns to 7.6 hrs.

Minimum Dead Time Between Pulses – 1.6 ns.

Resolution –

$$\pm LSD + \frac{1}{\sqrt{N}} \left(\frac{\pm \text{Start Trigger Jitter Error}}{\pm \text{Stop Trigger Jitter Error}} \right)$$

Accuracy – Resolution ±(Time Base Error x Width A) + (Stop Slew Rate Error – Start Slew Rate Error) ±2 ns.

Repetition Rate – ≥80 MHz.

TIME MANUAL
Range – 3.125 ns to 3.125 x 104 s (≈ 8 hrs).

Resolution – ±LSD 100 ms.

TOTALIZE A, A + B
Range – 0 to 10^{9} counts.

Repetition Rate – 0 to ≥350 MHz.

TOTALIZE A – B
Range – -1×10^{8} to 10^{12} (either A $>10^{12}$ or B $>10^{12}$ will cause overflow).

Repetition Rate – 0 to ≥350 MHz.

RISE/FALL A
Range – 5.0 ns to 7.6 hrs.

Repetition Rate -- Minimum time between rising (falling) edges is 12.5 ns (80 MHz).

Input Amplitude – (1.4 to 8 V) 1.4 Vp-p min, +4 to –4 VDC + peak AC max (50 Ω), (0.7 to 4 V) 700 mVp-p min, +2 to –2 VDC + peak AC max (1 MΩ).

Resolution –

$$\pm LSD + \frac{1}{\sqrt{N}} \left(\frac{\pm \text{Start Trigger Jitter Error}}{\pm \text{Stop Trigger Jitter Error}} \right)$$

Accuracy – Resolution ±(Time Base Error x Risetime/Falltime) ±2 ns ±4 mV x Slew Rate A Error (near 10%) ±4 mV Slew Rate A Error (near 90%).

RESOLUTION AND ACCURACY DEFINITIONS
Trigger Jitter Error (Seconds RMS) –

$$\frac{\sqrt{(e_{n1})^2 + (e_{n2})^2}\ \text{(Volts RMS)}}{\text{Input Slew Rate at Trigger Point}(V/s)}$$

Where: e_{n1}=140 μV RMS typical counter input noise for 1 MΩ filter on; 240 μV RMS typical for 1 MΩ, filter off and 340 μV RMS typical for 50 Ω and e_{n2}=RMS Noise Voltage of input signal at trigger point measured with 350 MHz bandwidth.

Slew Rate Error (Seconds) =

$$\frac{\text{Trigger Level Error (V)}^{*1}}{\text{Input Slew Rate at Trigger Point (V/s)}}$$

Trigger level error =

All functions except Width and Events B During A	Positive Slope	Trigger accuracy X attenuation factor
	Negative Slope	(Trigger accuracy ±10 mV) X attenuation factor
Width A	Start Edge	Trigger accuracy X attenuation factor
	Stop Edge	(Trigger accuracy + hyst) X attenuation factor
	Start Edge	(Trigger accuracy + hyst) X attenuation factor
	Stop Edge	Trigger accuracy X attenuation factor
Events B During A	Same as Width, except each number is multiplied by (Frequency B)	

Note: Input hysteresis is typically 50 mVp-p attenuation.
N = Number of events averaged.

The minimum number of averages is selected by the Averages button and the up and down buttons in decade steps from 1 to 10^{9}. At Channel A repetition rates above ≈ 250 Hz, the actual number of averages will be:

N=[Frequency A(Hz) x 4 ms] + Averages.

N=Averages setting (below 250 Hz).

This calculation typically leads to better than expected resolution in the displayed answer for small N with only minimal impact on measurement time. It does mean, however, that Arming must be used where only N=1 is for signals ≥250 Hz.

In the Auto mode, the counter measures with a fixed measurement time of about 300 ms (or the time for one event, whichever is greater).

N=Frequency A (Hz) x 0.3 s (N always ≥1).

Time Base Error – The sum of all errors specified for the time based used.

STANDARD HIGH STABILITY TIME BASE
Crystal Frequency – 10 MHz.

Temperature Stability – $\pm 2 \times 10^{-7}$ 0 to +50°C after warm-up.

Warm-Up Time – $+2 \times 10^{-7}$of final frequency in 10 minutes when cold started at 25°C.

Aging Rate – $\leq 1 \times 10^{-8}$/day at time of shipment, 4×10^{-8}/week after 30 days of continuous operation, 1×10^{-6}/year after 60 days of continuous operation.

Setability – Adjustable to within $\pm 2 \times 10^{-8}$.

REAR INTERFACE
Inputs – Arming; reset; external time base (1, 5, or 10 MHz), prescale.

Outputs – 10 MHz clock.

OTHER CHARACTERISTICS
Power Consumption – 19.3 W.

GPIB Data Output Rate – ≈10 readings/s maximum (DC 5010 only).

ORDERING INFORMATION

DC 5010
Programmable Universal Counter/Timer **$4,150**
Includes: Shaped Output Cable (012-0532-00); Instruction Manual (070-3897-02); Instrument Interfacing Guide (070-4611-00); Reference Guide (070-3553-00).

DC 510
Universal Counter/Timer **$3,995**

WARRANTY-PLUS SERVICE OPTIONS
Opt. M7 – Calibration Service
DC 5010 ..... **+$155**
DC 510 ..... **+$115**

Opt. M9 – Repair Protection
DC 5010 ..... **+$260**
DC 510 ..... **+$230**

CONVERSION KIT (DC 510)
IEEE Standard 488 Capability – Order 040-1023-06 ..... **$215**

PROBES
See Probe section on Page 423 for complete details.

General Purpose – 1X, 15 MHz, 100 pF/1 MΩ, 2 m.
Order P6101B **$60**

ACCESSORIES
See Accessory Section for additional accessories.

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

GPIB IEEE-488 — The DC 5010 complies with IEEE Standard 488.1-1987, and with Tektronix Standard Codes and Formats.

DC 5009
DC 509

Universal Counter/Timers

Powerful reciprocal-frequency measurements.

DC 5009/DC 509

- 135 MHz Both A and B Channels
- 10 ns Single-Shot Resolution
- 8-Digit Display
- 5 ps Resolution, with Averaging
- Reciprocal-Frequency Measurement; Period; Width; Time A – B; Events B During A; Totalize; Ratio; Time Manual; Arming
- Auto or Selected Averaging to 10^8 in All Modes
- Duty – Cycle Independent Autotrigger
- Shaped A and B Channel Outputs
- Probe Compensation
- High Stability Oven Time Base
- Single Wide Size

DC 5009/DC 509

The DC 5009/DC 509 single-width Universal Counter/Timers provide all of the measurement functions of the higher performance DC 5010/DC 510 except rise time/fall time, null, and totalize A ± B.

The powerful reciprocal-frequency measurement technique allows up to eight digits of resolution of low-frequency signals in one second or less of measurement time. The DC 5009/DC 509 has the same automatic averaging feature as the DC 5010/DC 510; selected averaging of up to 10^8 events provides usable time-interval resolution of 5 ps.

The TM 5000 rear-interfacing capability allows the DP 501 to be controlled over the GPIB through the DC 5009. The DP 501 extends frequency measurements to 1.3 GHz.

Characteristics

CHANNEL A AND B INPUT

Frequency Range – >0 to ≥135 MHz DC coupled; ≤10 Hz to ≥135 MHz AC coupled.

Sensitivity – ≤20 mV RMS (56.6 mVp-p) to ≥100 MHz, 40 mV RMS (113 mVp-p) from 100 MHz to ≥135 MHz, 115 mVp-p at minimum, pulse width of 3 ns.

Attenuation – Selectable 1X, 5X.

Impedance – 1 MΩ ±2% paralleled by ≤30 pF.

Trigger Level Range – +3.200 to –3.175 V with 25 mV resolution (X1), +16 to –15.875 V with 125 mV resolution (x5).

Trigger Level Accuracy – ±15 mV ±40 μV/°C referenced to 25°C.

Dynamic Range – 3.2 ≤input voltage ≤+3.2. X1: Vin p-p ≤3 V; X5: Vp-p 15 Vin (for input signal risetime p-p ≤3 V; X5: Vp-p 15 Vin); (for input signal risetimes ≤5 ns).

Autotrigger Frequency Range – Sensitivity ≤125 mVp-p x attenuation; ≤20 Hz to ≥100 MHz. Range: ±3.2 V x attenuation. Resolution: 25 mV x attenuation.

Independent Controls – Slope ±, attenuation 1X/5X, Couple AC/DC, Source Internal/External.

Maximum Input Voltage – 1X: ≤200 V peak; ≤400 Vp-p from DC to 50 kHz, ≤15 Vp-p at 135 MHz. 5X: ≤200 V peak; ≤400 Vp-p from DC to 5 MHz, ≤25 Vp-p at 135 MHz.

Shaped Out – Shaped replica of signal being measured, aids proper triggering on complex waveforms. Amplitude 0 V to ≥+0.3 V from 50 Ω.

Trigger Level Out – A DC level corresponding to the actual trigger level. Accuracy within ±10 mV of internal trigger level.

Arming Input – Permits measurements of complex waveforms. A TTL high allows averaging of selected events within a measurement.

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

GPIB IEEE-488 — The DC 5009 complies with IEEE Standard 488.1-1987, and with Tektronix Standard Codes and Formats.

Universal Counter/Timers

DC 5009
DC 509

FREQUENCY A
Range – ≤100 µHz to ≥135 MHz.

Resolution –

$$\pm LSD \pm 1.4 \times \frac{\text{A Trigger Jitter Error}}{N} \times (\text{Frequency A})^2$$

Accuracy – Resolution ±(Time Base Error x Frequency A).

PERIOD A
Range – ≤7.40 ns to ≥3.05 hrs.

Resolution –

$$\pm LSD \pm 1.4 \times \frac{\text{A Trigger Jitter Error}}{N}$$

Accuracy – Resolution ±(Time Base Error x Period A).

RATIO B/A
Range – 10^{-7} to 10^{8} (Frequency Range: CH A to ≥135 MHz; CH B to ≥125 MHz).

Resolution –

$$\pm LSD \pm 1.4 \times \text{B Trigger Jitter Error} \left(\frac{\text{Frequency B}}{N}\right)$$

Accuracy – Same as Resolution.

TIME A – B
Range – ≤15 ns to ≥3.05 hrs.

Minimum Dead Time – 15 ns (stop to start).

Resolution –

$$\pm LSD + \frac{1}{\sqrt{N}} \left(\frac{\pm\text{A Trigger Jitter Error}}{\pm\text{B Trigger Jitter Error}}\right)$$

Accuracy – Resolution ±(Time Base Error xTime A-B) + (B Trigger Slew Error-A Trigger Slew Error) ± (Channel Delay Mismatch).

Channel Delay Mismatch – <2 ns between front panel inputs and <2 ns between rear interface inputs.

Repetition Rate – <35 MHz.

EVENTS B DURING A
Range – 10^{-7} to 10^{8}.

Maximum B Frequency – 125 MHz.

Minimum A Pulse Width – 15 ns.

Minimum Time Between A Pulses – 15 ns.

Minimum Time Between "A" Start Edge and First "B" Event – 15 ns.

Resolution –

$$\pm LSD + \frac{\text{Freq. B}}{\sqrt{N}} \times \left(\frac{\pm\text{ Trig. Jit. Error CH A start edge}}{\pm\text{Trig. Jit. Ettor CH A stop edge}}\right)$$

Accuracy – Resolution + Frequency B (Stop Slew Rate Error – Start Slew Rate Error).

WIDTH A
Range – ≤15 ns to ≥3.05 hrs.

Minimum Dead Time Between Pulses – 15 ns.

Resolution –

$$\pm LSD + \frac{1}{\sqrt{N}} \left(\frac{\pm\text{Start Trigger Jitter Error}}{\pm\text{Stop Trigger Jitter Error}}\right)$$

Accuracy – Resolution ± (Time Base Error x Width A) + (Stop Slew Rate Error-Start Slew Rate Error) ±5 ns.

TIME MANUAL
Range – 0 to 3.05 hrs. May be extended with GPIB.

Resolution – ±LSD (100 ms).

Accuracy – ±Resolution ± (Time Base Error x Time).

TOTALIZE A
Range – 0 to 1.09 x 1012 counts. Extended with GPIB.

Repetition Rate – >0 to ≥135 MHz.

RESOLUTION AND ACCURACY: DEFINITIONS
For Trigger Jitter Error and Slew Rate Error definitions, see DC 503A.

N=Number of Events Averaged.

The minimum number of averages is selected by the averages control in decade steps from 1 to 10^{8}. At channel A repetition rates above ≈250 Hz, the number of events averaged will be:

N=[Frequency A (Hz) x 4 ms] + Averages.

N=Averages setting (below 250 Hz).

In the Auto mode, the counter measures with a fixed measurement time of about 300 ms.

N=Frequency A (Hz) x 0.3 s. (N is always ≥1).

Time Base Error – The sum of all errors specified for the time base used.

STANDARD HIGH STABILITY TIME BASE
Crystal Frequency – 10 MHz.

Temperature Stability – ±2 x 10^{-7} 0 to + 50°C after warm-up.

Warm-up Time – +2x10^{-7} of final frequency in 10 minutes when cold started at 25°C.

Aging Rate – ≤1x10^{-8}/day at time of shipment, 4x10^{8}/week after 30 days of continuous operation, 1x10^{-6}/year after 60 days of continuous operation.

Setability – Adjustable to within ±2 x 10^{-8}.

REAR INTERFACE
Inputs – Channel A and Channel B input to 50 MHz (50 Ω impedance, maximum input 3.6 V peak); arming; reset; external time base (1, 5 or 10 MHz), prescale.

Outputs – Channel A and Channel B shaped outputs; Channel A and Channel B trigger level outputs; 10 MHz clock; gate out.

OTHER CHARACTERISTICS
Power Consumption – 15 W.

GPIB Data Output Rate – ≈10 readings/s maximum (DC 5009 only).

ORDERING INFORMATION

DC 5009
Programmable Universal Counter/Timer **$2,250**
Includes: Tip Jack to BNC Adapter Cable (175-3765-01); Instrument Interfacing Guide (070-4612-00); Reference Guide (070-3560-01); Instruction Manual (070-3888-00).

DC 509
Universal Counter/Timer **$2,095**
Includes: Instruction Manual (070-3464-00).

WARRANTY-PLUS SERVICE OPTIONS
Opt. M7 – Calibration Service
DC 5009 ..... **+$110**
DC 509 ..... **+$90**

Opt. M9 – Repair Protection
DC 5009 ..... **+$200**
DC 509 ..... **+$190**

CONVERSION KIT (DC 509)
IEEE Standard 488 Capability – Order 040-0957-05 ..... **$450**

PROBES
See Probe Section on Page 423 for complete detail.
General Purpose – 1 X, 15 MHz 100 pF/1 MΩ, 2 m.
Order P6101B **$60**

ADDITIONAL ACCESSORIES
See Accessory Section for additional accessories.

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

GPIB IEEE-488 — The DC 5009 complies with IEEE Standard 488.1-1987, and with Tektronix Standard Codes and Formats.

DC 504A
DP 501

Counter/Timer Digital Prescaler

Our lowest cost modular counter operating is extended to 1.3 GHz (as are all Tektronix counters) with the use of DP 501 prescaler.

DC 504A

- DC to 100 MHz
- Period and Period Averaging
- Width and Width Averaging
- Autoranging
- 100X Resolution Multiplier
- Single Wide Size

DP 501

- Extends Counter Frequency Measurement Capability to 1.3 GHz
- Compatible with Most TM 500 and TM 5000 Counters
- AGC
- Low-Level Indicator
- GPIB Programmability with DC 5009 and DC 5010
- Single Wide Size

DC 504A

DC 504A

The easy-to-use DC 504A Counter/Timer measures frequency from DC to 100 MHz, with an internal prescaler being used for frequencies above 10 MHz. Both direct and prescaled counting are done through the same input connector; no need to change connectors when changing frequency range. Autoranging permits virtual hands-off operation for most measurements. The 100X resolution multiplier automatically provides 0.01 Hz resolution in one second or 0.001 Hz resolution in ten seconds on signals from 10 Hz to 25 kHz.

The DC 504A features period and width averaging of up to 1000 events. Selectable DC coupling of the input eliminates the potential errors associated with making width measurements on signals of varying duty cycle with counters that are only AC coupled. Input trigger sensitivity is 30 mV RMS across the entire 100 MHz frequency range. The trigger-level range of ±2 V and the selectable 5X attenuator provide a triggering range of up to ±10 volts.

The totalize mode permits totalizing up to 999,999 events – and beyond, with overflow – with a Display Update-Run/Hold control to hold the display while the internal counter continues to advance.

Characteristics

Display – Six-digit LED readout with automatic decimal-point positioning and leading-zero suppression. LED annunciators indicate gate open, resolution multiplier lock, and display overflow.

INPUT

Frequency Range – Front Panel: DC coupled to 100 MHz. AC coupled is 10 Hz to 100 MHz. Rear Interface: DC coupled is 0 to 50 MHz. AC coupled is 10 Hz to 50 MHz.

Sensitivity – 1X Attenuation: 30 mV RMS sinewave to 100 MHz; 85 mVp-p (at a minimum pulse width at 5 ns). 5X attenuation accuracy is within 2% at DC.

Attenuation – Selectable 1X, 5X.

Impedance – Front Panel, 1X, 5X: 1 M Ω, paralleled by ≈25 pF. Rear Interface, 1X, 5X: 50 Ω ±10% at DC.

Dynamic Range – 1X: 2.0 Vp-p signal within a ±2 VDC window. 5X: 10 V peak, ±10 VDC.

Trigger Level Range – ±2.0 V x attenuation minimum.

Maximum Input Voltage – Front Panel: 1X is 200 V peak; 400 Vp-p from DC to 50 kHz, derate to 15 Vp-p from 1.33 to 100 MHz. 5X is 200 V peak; 400 Vp-p from DC to 5 MHz, derate to 20 Vp-p at 100 MHz. Rear Interface: ≤4 V peak.

FREQUENCY TO 100 MHZ

Gate Time (Resolution) – 10 ms to 10 s (1 kHz to 1 Hz), selectable in decade steps; or autoranging (10 ms to 1 s only).

Accuracy – ±1 Count ±Time Base Error x Freq.

Prescale Factor – ÷10.

PERIOD AVERAGE

Range – DC Coupled: 0 Hz to 2.5 MHz. AC Coupled: 10 Hz to 2.5 MHz.

Resolution – 100 to 0.1 ns, in decade steps; or autoranging (100 to 1 ns only).

Events Averaged (N) – 10^0 to 10^3, in decade steps; or autoranging (10^0 to 10^2 only).

Accuracy –

$$\frac{\pm 100\ \text{ns}}{N} \pm \text{Time Base Error x Period}$$

$$\pm\ 1.4 \times \left(\frac{\text{Trigger Jitter Error}}{N}\right)$$

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

Counter/Timer Digital Prescaler

WIDTH AVERAGE

Range – DC Coupled: 200 ns to <10 sec. AC Coupled: 200 ns to 100 ms.

Resolution – $100\ ns/\sqrt{N}$

Events Averaged (N) –100 to 103, selectable in decade steps; or autoranging (100 to 102 only).

Accuracy –

$$\frac{100\ ns}{\sqrt{N}} \pm \text{Time Base Error x Width}$$

$$\pm \frac{\text{Start Trigger Jitter Error}}{\sqrt{N}}$$

$$+ \frac{\text{Stop Trigger Jitter Error}}{\sqrt{N}}$$

+ (Stop Slew Rate Error – Start Slew Rate Error) ±10 ns

TOTALIZE

Frequency Range – DC Coupled: >0 Hz to 10 MHz. AC Coupled: 10 Hz to 10 MHz. Overflows above 999,999. Display update Run/Hold will hold display while counter continues to advance. Releasing Run/Hold will update display to new value.

TIME BASE

Frequency (At Calibration) – 10 MHz $\pm 1 \times 10^{-7}$

Temperature Stability – $\pm 5 \times 10^{-6}$ (±5 ppm), 0 to + 50°C.

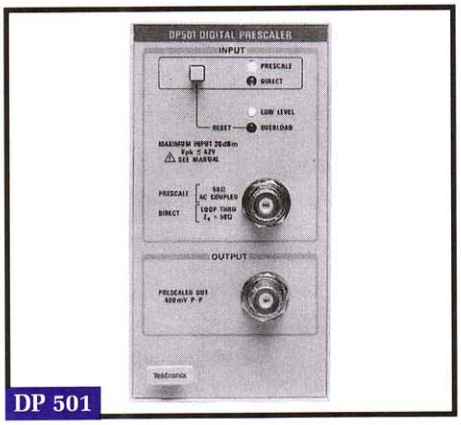
Adjustment Resolution – $\pm 5 \times 10^{-8}$

Aging Rate – $\leq 1 \times 10^{-6}$/year (≤1 ppm/year).

External Time Base Input – 10 MHz.

RESOLUTION AND ACCURACY DEFINITIONS

Same as DC 503A except DC 504A has 100 MHz bandwidth and input hysteresis =30 mVp-p typical.



DP 501

DP 501

The DP 501 Digital Prescaler adds 1.3 GHz frequency-counting capability to most counters, though it was designed specifically for use with the DC 503A, DC 509/DC 5009, and the DC 5010/DC 510 Universal Counter/Timers.

The DP 501 is placed in the signal line between the source and the counter's signal input and can be operated in either the Direct or the Prescale mode. The ÷16 prescaling function can be activated manually, with a front panel pushbutton, or via the GPIB when used with the DC 5009 or DC 5010.

Input sensitivity in the Prescale mode is 20 mV RMS to 1 GHz and 30-mV RMS to 1.3 GHz. A Low-Level indicator alerts the user if the input signal amplitude is too low for error-free counting. An automatic gain-control circuit provides optimum immunity to signal noise in the Prescale mode.

Characteristics

PRESCALE MODE INPUT

Frequency Range – ≤100 MHz to ≥1.3 GHz.

Sensitivity – 100 MHz to 1 GHz is ≤20 mV RMS (–21 dBm). 1 to 1.3 GHz is ≤30 mV RMS (–17 dBm).

Impedance – 50 Ω, AC coupled; vswr ≤2.2:1.

Output – Amplitude into 50 Ω is ≤200 mVp-p. Unterminated is 2X terminated value.

DIRECT MODE INPUT

(Connected directly to output.)

Frequency Range – 0 to >350 MHz.

Impedance – Loop through characteristic impedance is 50 Ω; nonterminated capacitance ≈20 pF (no connection to output).

Output – Connected directly to input. <1 dB insertion loss up to 350 MHz. Powers up in direct mode.

GENERAL

Overload Protection – Prescale: Input disconnects when input signal exceeds +20 dBm ±5 dBm.

Damage Level – Prescale: Input may be damaged if signal level exceeds +25 dBm. Direct: 42 V peak maximum. Maximum current is 250 mA.

Input Attenuation – Automatic: Up to 40 dB range.

Low Level Indicator – Lights when input signal is below that required for error-free counting.

ORDERING INFORMATION

DC 504A
Counter/Timer. **$845**
Includes: Instruction Manual (070-4291-00).

DP 501
Digital Prescaler **$995**
Includes: Instruction Manual (070-4332-00).

ACCESSORIES
See Accessory Section for compatible products.

WARRANTY-PLUS SERVICE OPTIONS

Opt. M7 – Calibration Service
DC 504A ..... **+$55**
DP 501 ..... **+$65**

Opt. M9 – Repair Protection
DC 504A ..... **+$100**
DP 501 ..... **+$80**

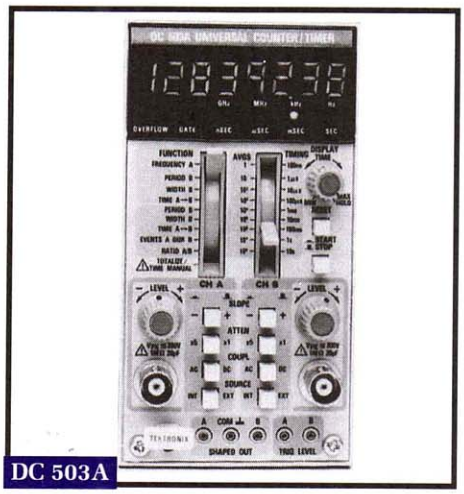
To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

Counter/Timer

Broad range of measurement features at an affordable price.

DC 503A

- 125 MHz Both A and B Channels
- 10 ps Resolution in Time–Interval Average with 10^8 Averages
- Measurement Functions include: Frequency; Period and Period Average; Width and Width Average; Time A–B; Time A–B Average; Events A During B Average; Totalize; Time Manual; Ratio A/B Average
- 40 MHz Rep Rate in Time–Interval Average
- Trigger–Level Outputs for Accurate Trigger Setting
- Shaped Outputs for Ease of Triggering
- Designed for True Probe Compatibility
- High Stability Oven Time Base
- Single Wide Size



DC 503A

DC 503A

The DC 503A offers a broad range of measurement features at an affordable price. The instrument has two input channels, A and B, each with 125 MHz capability. Each channel has separate triggering level, triggering slope, attenuator, and coupling mode controls. Eight measurement functions are available with the DC 503A, and an averaging feature allows averaging of 1 to 10^8 occurrences of the signal of interest. Signals to be counted or timed can be applied to channels A and B via front-panel BNC connectors or through rear-interface connections. The DC 503A features an easy-access front panel and an LSI-based design for increased instrument reliability.

The DC 503A is equipped with a temperature-controlled 10 MHz crystal oscillator to obtain a highly stable and precise internal time base.

Characteristics

Display – Eight digit LED; indicators for units, gate open, and overflow.

Display Time – ≈0.2 s to 5 s and hold.

CHANNEL A AND B INPUT

Frequency Range – 0 to ≥MHz, DC coupled. 10 Hz to ≥125 MHz, AC coupled.

Sensitivity – 20 mV RMS sinewave to 100 MHz. 60 mVp-p at minimum pulse width (of 5 ns to 100 MHz). 35 mV RMS sinewave to 125 MHz. 100 mVp-p (minimum pulse width of 4 ns to 125 MHz).

Attenuation – Selectable 1X, 5X.

Impedance – 1 MΩ paralleled by ≈27 pF.

Dynamic Range – Vp-p ≤3 V x attenuation.

Trigger Level Range – Adjustable ±3.5 V x attenuation.

Trigger Level Output Accuracy – ±0.5% of reading for a DC input V, ±20 mV.

Independent Controls – Slope ±, Attenuation 1X/5X, Coupled AC/DC, Source Internal/External.

Maximum Input Voltage – IX: ≤200 V peak; ≤400 V p–p from DC to 50 kHz, ≤15 Vp-p from 1.33 to 125 MHz. 5X: ≤200 V peak; ≤400 Vp-p from DC to 5 MHz, derate to ≤20 Vp-p from 100 to 125 MHz.

Shaped Out – Shaped replica of signal being measured, aids proper triggering on complex waveforms. ≤200 mVp-p from 50 Ω.

FREQUENCY A

Range – 0 to 125 MHz.

Resolution – 0.1 Hz to 10 MHz in decade steps.

Accuracy – ±1 count ±Time Base Error.

PERIOD B (SINGLE SHOT)

Range – 100 ns to 10^9 s.

Resolution – 100 ns to 10 s in decade steps.

Accuracy – ±count ±Time Base Error x Period B ±1.4 x Channel B Trigger Jitter Error.

Frequency Range – 125 MHz.

PERIOD B (AVERAGE)

Range – 8 ns to 10 s.

Resolution – 1 fs (10^{-15}) to 100 ns in decade steps.

Events Averaged (N) – 1 to 10^8.

Accuracy –

$$\pm\frac{100\text{ ns}}{N} \pm \text{Time Base Error x Period B}$$

$$\pm\frac{1.4\text{ x Channel B Trigger Jitter Error}}{N}$$

Frequency Range – 0 to ≤125 MHz.

RATIO A/B

Averaged over 1 to 10^8 cycles of Channel B signal.

Frequency Range – 0 to ≤125 MHz (both Channel A and Channel B).

Accuracy –

$$\pm\frac{\text{Frequency B}}{\text{Frequency A x N}}$$

$$\pm\frac{1.4\text{ x Channel B Trig Jitter Error x Freq A}}{N}$$

$$\pm\frac{\text{Frequency A}}{0.3 \text{ x } 10^8}$$

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

Counter/Timer

TIME A → B (SINGLE SHOT)
Range – 100 ns to 10^9 s.

Resolution – 100 ns to 10 s in decade steps.

Accuracy – ±1 count ±Time Base Error x Time AB; ±Channel A Trigger Jitter Error; ±Channel B Trigger Jitter Error; ±(Channel B stop Trigger Slew Error; –Channel A start Trigger Slew Error) ±4 ns.

TIME A → B (AVERAGE)
Range – 12.5 ns to 10 s.

Minimum Dead Time – 12.5 ns (stop-to-start).

Resolution – $100\ ns/\sqrt{N}$

Events Averaged (N) – 1 to 10^8 in decade steps.

Accuracy –

$$\pm\frac{100\ ns}{\sqrt{N}} \pm \text{Time Base Error x Time A} \rightarrow \text{B}$$

$$\pm\frac{\text{Channel A Trigger Jitter Error}}{\sqrt{N}}$$

$$\pm\frac{\text{Channel B Trigger Jitter Error}}{\sqrt{N}}$$

+(Channel B stop Trigger Slew Error – Channel A start Trigger Slew Error) ±4 ns

EVENTS A DURING B (AVERAGE)
Maximum A Frequency – ≤125 MHz.

Minimum B Pulse Width – 5 ns.

Events Averaged (N) – 1 to 10^8 in decade steps.

Accuracy –

$$\pm\frac{\text{Period A}}{\text{Width B x}\sqrt{N}}$$

$$\pm\frac{\text{Channel B start Trigger Jitter Error}}{\sqrt{N}}$$

$$\pm\frac{\text{Channe B stop Trigger Jitter Error}}{\sqrt{N}}$$

WIDTH B (SINGLE SHOT)
Range – 100 ns to 10^9 s.

Resolution – 100 ns to 10 s in decade steps.

Accuracy – ±1 count ±Time Base Error x Width B ±Channel B start Trigger Jitter Error ±Channel B stop Trigger Jitter Error ±(Channel B stop Slew Rate Error–Channel B start Slew Rate Error).

WIDTH B (AVERAGE)
Range – 5 ns to 10 s.

Resolution – $100\ ns/\sqrt{N}$

Events Averaged (N) – 1 to 10^8 in decade steps.

Accuracy – ±1 Count ±B Trig. Jit. Error (rising edge); ±B Trig. Error (falling edge) ±Time Base Error.

Frequency Range – 0 to 100 MHz.

TIME MANUAL
Electronic stopwatch, accumulates and displays time between activation of front panel start/stop button or rear interface signal line. Clock rates selectable from 100 ns to 10 s in decade steps. Range 100 ns to 10^9 s.

TOTALIZE A
1 count to 99,999,999 counts at maximum rate of 125 MHz. Start, stop and reset controlled by front panel pushbuttons or rear interface signal lines.

RESOLUTION AND ACCURACY DEFINITIONS
Time Base Error is the sum of all errors specified for the time base used.

N is the number of periods averaged in Period B (AVGS) mode, the number of intervals averaged in the Time A–B (AVGS) mode, the number of widths of B averaged in Width B (AVGS) and Events A During B modes, and the number of periods of B in the Ratio A/B mode.

Trigger Jitter Error (in μs) –

$$\frac{\sqrt{(en_1)^2 + (en_2)^2\ (V)}}{\text{Input Slew Rate at Trigger Point}(V/\mu s)}$$

Where: e_{n1} =100 μV RMS typical internal noise
e_{n2} =RMS noise of signal input at trigger point for a 125 MHz bandwidth

Trigger Slew Rate Error (in μs) –

$$\frac{\text{Input Hysteresis}(V)/2}{\text{Input Slew Rate as set Trigger Point}(V/\mu s)}$$

Where: Input hysterisis = 20 mVp-p typical.

OTHER CHARACTERISTICS
HIGH STABILITY STANDARD TIME BASE
Crystal Frequency – 10 MHz.

Temperature Stability – <±2 x 10^{-7} after warm-up, 0 to +50°C.

Warmup Time – Within 2 x 10^{-7} of final frequency in <10 minutes when cold started at 25°C.

Aging Rate – 1 x 10^{-8}/day at time of shipment 4 x 10^{-9}/week after 30 days of continuous operation, 1x 10^{-6}/year after 60 days of continuous operation.

Setability – Adjustable to within 2 x 10^{-8}

REAR INTERFACE
Inputs – Direct count input to 50 MHz, (50 Ω) impedance, resistor may be removed for 1 MΩ impedance, remote start/stop, reset; external time base.

Outputs – BCD serial-by-digit, decimal point overflow, scan clock; trigger level; time base reference.

ORDERING INFORMATION

DC 503A
Universal Counter/Timer **$1,825**
Includes: Instruction Manual (070-2971-00).

WARRANTY-PLUS SERVICE OPTIONS
Opt. M7 – Calibration Service ..... **+$90**
Opt. M9 – Repair Protection ..... **+$125**

OPTIONAL COUNTER ACCESSORIES
Power Divider GR, 50 Ω – Order 017-0082-00 ..... **$1,095**
Adapters – (GR to BNC female) Order 017-0067-00 ..... *1
(GR to BNC male) Order 017-0064-00 ..... **$140**

Cable Adapters – BNC to Tip Jack. Order 175-3765-01 ..... **$65**

RECOMMENDED PROBES
See Probe Section on Page 423 for complete detail.
P6101B – 1X, DC to 15 MHz **$60**
P6106A – 10X, DC to 300 MHz **$190**
P6201 – FET, DC to 900 MHz **$1,495**

**1 Please contact your local Tektronix representative for price and ordering information.*

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

Modular Oscilloscopes

CONTENTS

MODULAR OSCILLOSCOPES
SC 504 337
SC 503 338
SC 502 338
SC 501 340

Modular Oscilloscopes

The family of Modular Oscilloscopes for the TM 500/TM 5000 family provides waveform capture and viewing capability in a compact size. The SC family provides an ideal, size-conscious solution to your signal viewing needs whether mounted in a rack or on an engineering bench.

OSCILLOSCOPE SELECTION GUIDE

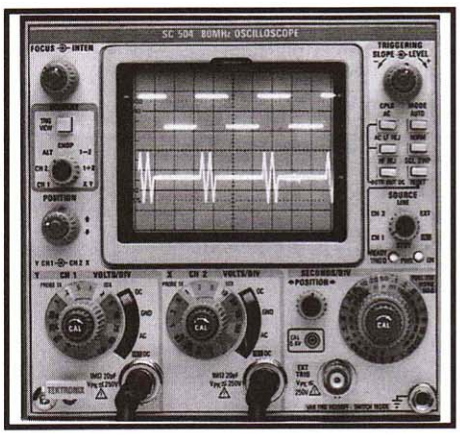
	SC 504	SC 503	SC 502	SC 501
Bandwidth (MHz)	80	10	15	5
Number of Channels	2	2	2	1
Sensitivity (mV/div)	5	1	1	10
Vertical Accuracy	±2%	±3%	±2%	±3%
Max Input Voltage:				
V (DC + peak AC)	250	350	350	350
V (p-p at 1 kHz)	500	700	700	
Sweep Rate (/div)	50 ns to .2 s	500 ns to 2 s	200 ns to .5 s	1 µs to 100 ms
With x10 Mag	5 ns	50 ns	20 ns	NA
	21 Steps	21 Steps	20 Steps	
	1-2-5 Sequence	1-2-5 Sequence	1-2-5 Sequence	Decade Steps
Module Size	2 Wide	2 Wide	2 Wide	1 Wide
Step Response Aberrations	±4%	±2%, ≤3% p-p	±2%, ≤3% p-p	–
AC Coupled Low-Frequency Response (Hz)		≤10, 1, w/10X probe *1	≤10, 1, w/10X probe *1	
Deflection Factors (V/div)	5 m to 10, 1-2-5 sequence; continuously variable between 11 calibrated steps	1 m to 20, 1-2-5 sequence; between 4 calibrated steps	continuously variable	10 m, 100 m, 1 continuously variable
Continuously Variable To	0.5 s/div	5 s/div	1.25 s/div	1 s/div
Sweep Rate Accuracy*2	±3%, 0.2 s to 50 ms/div; ±2%, 20 ms to 0.2 µs/div; ±3% 0.1 µs to 50 ns/div	±4%, 2 s to 0.5 s/div; ±3%, 0.2 s to 5 µs/div; ±4%, 2 µs to 0.5 µs/div	±3%, all rates	±5%, all rates
X-Y Mode:				
Bandwidth (Hz)	DC to 2 M	DC to 500K	DC to 2 M	DC to 100K
Phase Diff.		3° at 50 kHz		–
Trigger Sensitivity (min. p-p signal)				
Coupling	DC to 30 / 30 to 80	DC to 5 / 5 to 10	DC to 5 / 5 to 15	DC to 5
Source (MHz)				
DC CH 1, CH 2 (div)	0.4, 60 mV / 1, 150 mV	0.4 / 1	0.4 / 1	0.4
Ext, Rear Interface	typ. 50 mv / 100 mV to 50 MHz	35 to 60 mV / 80 to 150 mV	60 mV / 150 mV	5 V
AC	Requirements increase below 50 Hz	Requirements increase below 50 Hz	Requirements increase below 50 Hz	NA
AC LF Rej.	Requirements increase below 10 kHz	Requirements increase below 10 kHz	Requirements increase below 5 kHz	NA
AC HF Rej.	Requirements increase above 50 kHz		NA	NA

*1 *Optimum bandwidth, rise time, aberrations, and deflection-factor accuracy. Expect lower performance for other temperature ratings and attenuator settings.*

*2 *Accuracy at 15 to 35°C, XI magnifier. Derate additional 1% for X10 magnifier on, and an additional 1% for operation at 0 to 15°C and 35 to 50°C.*

Modular Oscilloscope

80 MHz



SC 504

The SC 504 is a general-purpose, dual-trace, nondelayed-sweep oscilloscope. It has a high writing speed with a maximum sensitivity of 5 mV/div and a maximum sweep rate of 5 ns/div (with magnifier). This oscilloscope features Add (CH 1 plus CH 2), differential (CH 1 minus CH 2), and "true" X-Y modes, and also includes rear-interfacing capability (switchable CH 1, CH 2, and ext trig inputs). Enhanced autotriggering, trigger view, and variable trigger holdoff make this oscilloscope very versatile and easy to use.

Characteristics

VERTICAL DEFLECTION

Bandwidth At –3 dB Points – DC to >50 MHz to 35°C, >70 MHz to 50°C.

Rise Time – 4.4 ns.

Accuracy – ±2%, +15°C to +35°C; ±3% 0 to 50°C.

Step Response Aberrations – ±4% to 35°C.

AC Coupled Low-Frequency Response – ≤ –10 Hz, 1 Hz with X10 probe.

Deflection Factors – 5 mV/div to 10V/div in a 1-2-5 sequence of 11 steps plus variable.

Input R&C – 1 MΩ ±1%, 20 pF.

Maximum Input Voltage – 250 V (DC + peak AC), 500 Vp-p at 1 kHz.

CMRR (CH 1 minus CH 2) – >50:1 at 1 MHz.

Calibrator – 0.6 V ±1%, ≈ 1 kHz.

HORIZONTAL DEFLECTION

Time Base – 0.2 s to 50 ns/div, 21 steps in a 1-2-5 sequence, plus X10 magnifier to 5 ns/div.

Sweep Accuracy – 15 to 35°C.
X1, ±3%; X10, ±4%; 0.2 s/div to 50 ms/div;
X1, ±2%; X10, ±3%; 20 ms/div to 0.2 µs/div;
X1, ±3%; X10, ±4%; 0.1 µs/div to 50 ns/div.

X-Y Mode Bandwidth – DC to 2 MHz.

TRIGGERING

Coupling – DC, AC, AC LF REJ, HF REJ.

Trigger Sensitivity (min p-p signal) DC Coupling –

Source	≤30 MHz	30 M to 80 MHz
CH 1 and CH 2	0.4 div.	1.5 div., 150 mV
Ext. Rear Int.	60 mV	100 mV to 50 MHz

Triggering Level Range – Ext ≥1.4 V.

AVAILABLE REAR CONNECTIONS

Z Axis In, CH 1 Trig Out, CH 1 & CH 2 In, Triged Gate Out, Trig In, Ramp Out, Ext Gate In, Sweep Gate Out, Gate Select In, Light Out, Intensity In, Hold Off Out, Reset In.

CRT

Phosphor – GH (P31).

Accelerating Potential – 12 kV.

Graticule – 8X10 div (0.25 in./div) internal graticule lines.

SC 504

- 80-MHz Bandwidth
- 5-mV/div Maximum Sensitivity
- 5-ns/div Maximum Calibrated Sweep Rate
- Enhanced Automatic Triggering
- True X-Y Capability
- Switchable Rear-Interface Capability
- Two Wide Size

Versatile and easy to use.

ORDERING INFORMATION

SC 504
80 MHz Oscilloscope. Order 070-2296-00 ..... **$5,295**

WARRANTY-PLUS SERVICE OPTIONS
Opt. M7 – Calibration Service ..... **+$145**
Opt. M9 – Repair Protection ..... **+$280**

PROBES
Differential – 100 MHz, Active Differential, 6ft. Order P6046 .. **$2,195**

High Voltage –
100X, 120 MHz, 1500 V, 2.5 pF/10 MΩ, 9ft. Order P6009 ..... **$265**
1000X, 75 MHz, 20 kV, 3.0 pF/100 MΩ, 10ft. Order P6015A **$895**

General Purpose –
1X, 15 MHz, 100 pF/1 MΩ, 2 m. Order P6101B **$60**
10X, 100 MHz, 11.2 pF/10 MΩ, 2 m. Order P6108A **$145**
1X-10X Switchable, 1X: 8 MHz, 100 pF/1 MΩ, and 10X: 100 MHz,16 pF/10 MΩ, 2 m. Order P6129B **$95**

Logic – 20 MHz, 17 bit, Word Recognizer/Trigger. Order P6408 ..... **$425**

Current –
(AC only) 120 Hz-60 MHz, 7.5A peak. Order P6021 ..... **$545**
(AC only) 935 Hz-120 MHz, 3A peak. Order P6022 ..... **$595**
(DC & AC) DC-50 MHz System. Order AM503S **$2,595**
Includes: AM503A, Current Probe Amplifier, A6302 Current Probe, and TM502 Mainframe.

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

SC 503
SC 502

Modular Oscilloscopes
10 MHz and 15 MHz

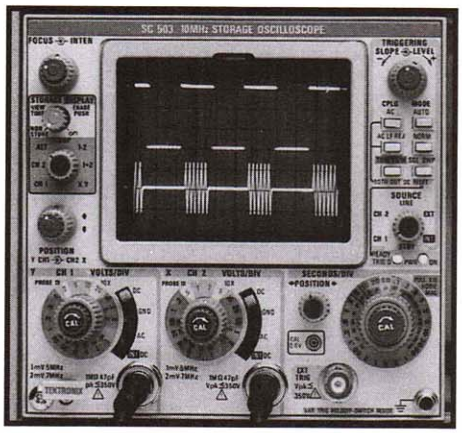
Store and display waveforms after input signal removed with our only Analog Bi-Stable Storage Scope.

SC 503

- 10-MHz Bandwidth, Dual Trace
- 50-ns/Div Maximum Calibrated Sweep Rate
- 1-mV/Div Maximum Sensitivity
- Bistable Storage Autoerase
- Trigger View, Variable Trigger Holdoff
- Switchable Front/Rear X and Y Inputs
- Rear Z-Axis Input
- True X-Y Capability

SC 502

- 15 MHz Bandwidth, Dual Trace
- 20 ns/Div Maximum Calibrated Sweep Rate
- 1 mV/Div Maximum Sensitivity
- Delay Line
- Trigger View, Variable Trigger Holdoff
- Enhanced Automatic Triggering
- Two Wide Size



SC 503

The SC 503 is a non-delayed sweep, general purpose storage oscilloscope which can be used to store and display waveforms after the input signal has passed. This feature is particularly useful when measuring slow repetition rates or single-shot signals, important in the biomedical and mechanical measurements fields. Low frequency signals at heart or respiration rates can be stored for detailed analysis. In the mechanical measurements field the SC 503 can "freeze" fast or transient signals from transducers, which is especially useful in pressure-and velocity-versus-time analysis and shock testing.

Important storage applications of the SC 503 include measurement of signals in computer peripherals, communication terminals, and industrial control systems.

The SC 503 also features an autoerase mode that erases the stored signal and automatically retriggers the oscilloscope, and X-Y capability. The X-Y capability allows creation of Lissajous patterns in many cause-and-effect testing relationships including: acoustic-speech testing, nerve-potential testing, and optical-stimulus-response testing.

Characteristics

VERTICAL DEFLECTION

Bandwidth at –3 dB – 5 mV to 20 V/div, >10 MHz; 2 mV/div, >7 MHz; 1 mV/div, >5 MHz.

Rise Time – 35 ns, 5 mV to 20 V/div.

Step Response Aberrations – ±2%, ≤3% p-p.

AC Coupled Low-Frequency Response – ≤10 Hz, 1 Hz with X10 probe.

Deflection Factors – 1 mV/div to 20 V/div in a 1-2-5 sequence of 14 steps plus variable.

Accuracy – 5 mV to 20 V/div, ±3%; 1 mV/div and 2 mV/div, ±5%.

Input R&C – 1 MΩ ±1%, 47 pF.

Maximum Input Voltage – 350 V (DC + peak AC), 700 Vp–p at 1 kHz.

CMRR (CH 1 minus CH 2) – >30:1 at 1 MHz.

Channel Isolation – ≤2% to 10 MHz.

Displayed Noise – ≤0.2 mVp-p at 1 mV/div.

Calibrator – 0.6 V ±1%, ≈ 1 kHz.

Delay Line – Permits viewing leading edge of displayed waveform.

HORIZONTAL DEFLECTION

Time Base – Calibrated range from 500 ns/div to 2 s/div, 21 steps in 1-2-5 sequence, X10 magnifier to 50 ns/div.

Sweep Accuracy*1 –
±4%, 2 s/div to 0.5 s/div;
±3%, 0.2 s/div to 5 µs/div;
±4%, 2 µs/div to 500 ns/div.

X-Y Mode Bandwidth – DC to 500 kHz.

TRIGGERING

Coupling – DC, AC, AC LF REJ.

Trigger Sensitivity (min p-p signal) DC Coupling –

Source	≤5 MHz	5 MHz to 10 MHz
CH 1 and CH 2	0.4 div.	1 div
Ext. Rear Int.	35 mV to 60 mV	80 mV to 150 mV

Triggering Level Range – V Ext ≥1.2 V, Int ≥6 div.

AVAILABLE REAR CONNECTIONS

Z Axis In	CH 1 Trig Out
CH 1 & CH 2 In	Triged Gate Out
Trig In	Ramp Out
Ext Gate In	Sweep Gate Out
Gate Select In	Light Out
Intensity In	Hold Off Out
Reset In	Erase Function

CRT

Phosphor – GX (P44).

Accelerating Potential – 2 kV.

Graticule – 8x10 div (0.25 in / div) internal graticule lines.

STORAGE SYSTEM

Stored Writing Speed (Center 68 Divisions) – At least 80 div/ms (50 cm/ms).

Erase Time – 400 to 600 ms.

Autoerase Viewing Time – Continuously variable from 0.5 to 5 s.

Maximum Recommended Storage Time – 4 hrs.

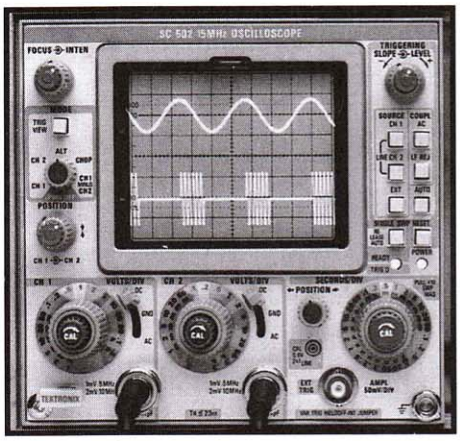
**1 Accuracy at 15° to 35°C, X1 magnifier. Derate additional 1% for X10 magnifier on, and an additional 1% for operation at 0° to 15°C and 35° to 50°C.*

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

Modular Oscilloscopes

10 MHz and 15 MHz

SC 503
SC 502



SC 502

The SC 502 is a compact general-purpose, 15 MHz dual-trace oscilloscope with high writing speed, a wide range of sweep rates, a wide range of deflection factors, and versatile triggering, including trigger view and enhanced automatic triggering.

The SC 502 is intended to be a powerful tool in the field servicing of digital equipment. The CRT of the SC 502 offers a high writing speed as an advantage in the display of digital information, while stable, clean triggering is assured by incorporating well-proven circuits. Thus, the SC 502 offers a unique combination of performance, compactness, and systems capability.

The rear-interfacing capability of the SC 502 and all TM 500/TM 5000 instrumentation suggests exceptional applicability to systems of built-in test equipment or rackmounted installations.

Characteristics

VERTICAL DEFLECTION

Bandwidth at –3 dB – 5 mV to 20 v/div, >15 MHz; 2 mV/div, >10 MHz; 1 mV/div, >5 MHz.

Rise Time – 23 ns.

Step Response Aberrations – ±2%, ≤3 p-p.

AC Coupled Low-Frequency Response – ≤10 Hz, 1 Hz with X10 probe.

Deflection Factors – 1 mV/div to 20 V/div in a 1-2-5 sequence of 14 steps plus variable.

Input R&C – 1 MΩ ±1%, 47 pF.

Accuracy – 5 mV to 20 V/div, <2%; 1 mV to 2 mV/div, <5%.

Maximum Input Voltage – 350 V (DC + peak AC), 700 Vp–p at 1 kHz.

CMRR (CH 1 minus CH 2) – >30:1 at 1 MHz.

Channel Isolation – ≤2% to 15 MHz.

Displayed Noise – ≤0.2 mVp-p at 1 mV/div.

Calibrator – 0.6 V ±1%, ≈ twice power-line frequency.

HORIZONTAL DEFLECTION

Time Base – Calibrated range from 0.2 µs/div to 0.5 s/div, 20 steps in 1-2-5 sequence, X10 magnifier to 20 ns/div.

Sweep Accuracy*1 –
±3%, 0.5 s/div to 0.1 s/div;
±2%, 50 ms/div to 1 µs/div;
±3%, 0.5 µs/div to 0.2 µs/div

X-Y Mode Bandwidth – DC to 2 MHz.

TRIGGERING

Coupling – DC, AC, AC LF REJ.

Trigger Sensitivity (min p-p signal) DC Coupling –

Source	≤30 MHz	30 M to 80 MHz
CH 1 and CH 2	0.4 div.	1.5 div., 150 mV
Ext. Rear Int.	60 mV	100 mV to 50 MHz

Triggering Level Range – Ext ≥1.2 V, Int ≥8 div.

AVAILABLE REAR CONNECTIONS

Ext (Delayed) Gate In, Trig Gate Out, Gate Select In, Hold Off Out, Intensity In, Ramp Out, CH 1 Trig Out.

CRT

Phosphor – GH (P31).

Accelerating Potential – 12 kV.

Graticule – 8X10 div (0.25 in/div) internal graticule lines.

[1]Accuracy at 15° to 35°C, X1 magnifier. Derate additional 1% for X10 magnifier on, and an additional 1% for operation at 0° to 15°C and 35° to 50°C.

ORDERING INFORMATION

SC 503
10-MHz Storage Oscilloscope. (070-3438-00) **$4,995**
Includes: Instruction Manual.

SC 502
15-MHz Oscilloscope. (070-1878-01). **$3,295**
Includes: Instruction Manual.

WARRANTY-PLUS SERVICE OPTIONS

Opt. M7 – Calibration Service
SC503 ..... **+$145**
SC502 ..... **+$115**

Opt. M9 – Repair Protection
SC503 ..... **+$335**
SC502 ..... **+$260**

PROBES

Differential – 100 MHz, Active Differential, 6 ft. Order P6046 .. **$2,195**

High Voltage –
100X, 20 MHz, 1500 V, 2.5 pF/10 MΩ, 6 ft. Order P6007 ..... **$160**
1000X, 75 MHz, 20 V, 3.0 pF/100 MΩ, 10 ft. Order P6015A **$895**

General Purpose –
1X, 15 MHz, 100 pF/1 MΩ, 2 m. Order P6101B **$60**
10X, 100 MHz, 13.2 pF/10 MΩ, 2 m. Order P6102A **$145**
1X-10X Switchable, 1X: 7 MHz, 105 pF/1 MΩ, 6 ft. and 10X: 100 MHz,14 pF/10 MΩ, 6 ft. Order P6062B **$240**

Current –
(AC only) 120 Hz-60 MHz, 7.5 A peak. Order P6021 ..... **$545**
(AC only) 935 Hz-120 MHz, 3 A peak. Order P6022 ..... **$595**
(DC & AC) DC-50 MHz System. Order AM503S **$2,595**
Includes: AM503A, Current Probe Amplifier, A6302 Current Probe, and TM502 Mainframe.

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

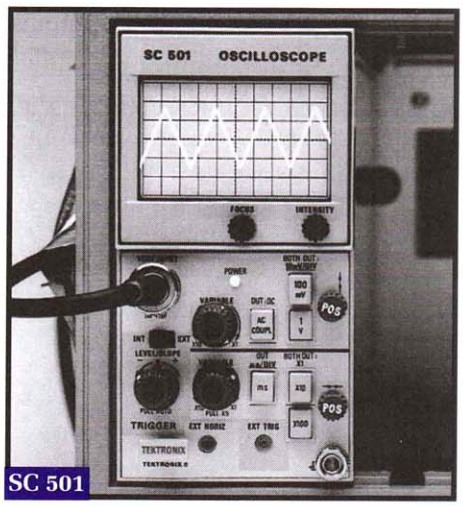
Modular Oscilloscope

5 MHz

Use on the bench, in the rack, or on the road.

SC 501

- 5-MHz Bandwidth
- Single Compartment Size
- 6.4-cm (2.5 in.) CRT



SC 501

SC 501

The SC 501 is a single-channel, 5-MHz plug-in-unit oscilloscope with a 2.5-inch CRT display that occupies a single TM 500/TM 5000 series plug-in compartment. Since the SC 501 fits any TM 500 or TM 5000 mainframe, it can be used on the bench, in a rack, or on the road.

Calibrated sweep rates are selected by push-button logic in decade steps from 1 s/div to 100 ms/div. A variable control extends the slowest sweep rate to at least 1 s/div and a fixed magnifier extends the fastest sweep rate to 200 ns/div. A 0 to 10-V ramp for all sweep rates (excluding the X5 magnification) is provided at a rear-interface connector.

Characteristics

VERTICAL DEFLECTION

Bandwidth – DC to >5 MHz.

AC Coupled Low-Frequency Response – ≤2 Hz.

Deflection Factors – 10 mV/div, 100 mV/div, and 1 V/div continuously variable.

Accuracy – <3%.

Input R&C – 1 MΩ ±1%, 47 pF.

Maximum Input Voltage – 350 V (DC + peak AC).

HORIZONTAL DEFLECTION

Time Base – 1 µs/div to 100 ms/div, X5 multiplier provides 200 ns/div.

Accuracy – ≤5% for all sweep rates.

CRT AVAILABLE REAR CONNECTIONS

Ramp out, Vert in, Ext Trig, Ext Horiz.

CRT Phosphor – GH (P31).

CRT Accelerating Potential – 1 kV.

CRT Graticule – 6X10 div (0.2 in/div).

Custom Plug-in Kits

SINGLE COMPARTMENT WITH POWER SUPPLY BOARD (040-0803-02)

The kit includes parts and a pre-etched circuit board layout for (1) a ground-referenced positive and negative supply, capable of 7 to 20 V at up to 400 mA, and (2) a ground-reference supply, nominally 5 V, not adjustable, with up to 1 amp current capability. The circuit board includes the edge-connector interface and has about 30 square inches of 0.1 in. grid perforated board with plated holes for circuit development.

SINGLE COMPARTMENT WITH DEVELOPMENT BOARD (040-0652-05)

This kit comes without the power supply components. The board includes the edge-connector interface and has about 35 square inches of board development area.

SINGLE COMPARTMENT WITHOUT BOARD (040-0821-03)

This kit comes without a board for applications where custom circuit boards are fabricated.

DUAL COMPARTMENT WITH DEVELOPMENT BOARDS (040-0754-07)

This kit has two development boards (30 and 35 square inches of development area) for applications requiring additional power, circuit area, or front panel space.

ORDERING INFORMATION

SC 501

5-MHz Oscilloscope. (070-1700-01). **$2,995**

Includes: Instruction Manual.

WARRANTY-PLUS SERVICE OPTIONS

Opt. M7 – Calibration Service ..... **+$90**

Opt. M9 – Repair Protection ..... **+$155**

PROBES

Differential – 100 MHz, Active Differential, 6 ft. Order P6046 .. **$2,195**

High Voltage –

100X, 20 MHz, 1500 V, 2.5 pF/10 MΩ, 6 ft. Order P6007 ..... **$160**

1000X, 75 MHz, 20 V, 3.0 pF/100 MΩ, 10 ft. Order P6015A **$895**

General Purpose –

1X, 15 MHz, 100 pF/1 MΩ, 2 m. Order P6101B **$60**

10X, 100 MHz, 13.2 pF/10 MΩ, 2 m. Order P6102A **$145**

1X-10X Switchable, 1X: 7 MHz, 105 pF/1 MΩ, 6 ft. and 10X: 100 MHz,14 pF/10 MΩ, 6 ft. Order P6062B **$240**

Current –

(AC only) 120 Hz-60 MHz, 7.5 A peak. Order P6021 ..... **$545**

(AC only) 935 Hz-120 MHz, 3 A peak. Order P6022 ..... **$595**

(DC & AC) DC-50 MHz System. Order AM503S **$2,595**

Includes: AM503A, Current Probe Amplifier, A6302 Current Probe, and TM502 Mainframe.

Single Compartment with Power Supply Board – Order 040-0803-03 ..... **$160**

Single Compartment with Uncommitted Board – Order 040-0652-06 ..... **$135**

Single Compartment Without Board – Order 040-0821-04 ..... **$70**

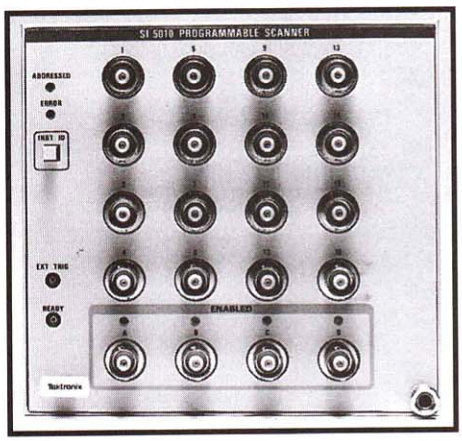
Double Compartment with Two Boards – Order 040-0754-07 ..... **$260**

Rear-Interface Data Book – Order 070-2088-04 ..... **$33**

Flexible Extender Cable – Order 067-0645-02 ..... **$470**

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

Programmable Scanner/Multiplexer



SI 5010

The SI 5010 Programmable Scanner switches and routes up to 16 high-frequency input and/or output signals. It maintains a clean 50 Ω environment through the use of 50 Ω coaxial reed relays. The software-configurable basic four-channel arrangement allows the SI 5010 to be used for point-to-point switching (any connector to any other connector), or to be used in a wide variety of fan-in and/or fan-out configurations.

The SI 5010 has a built-in command buffer capable of storing up to 300 GPIB system commands and executing them in sequence. It is paced by the on-board time-of-day and pacing clock or by signals from the system under test. This requires no interference from the system controller, thus freeing the controller to direct activity elsewhere in the system. TTL compatible handshake lines are provided for externally controlling the SI 5010.

Two handshake lines are provided for externally controlling the SI 5010. An Ext Trig line is provided to allow the SE 5010 switching to be initiated by the external system under test, and a Ready line indicates to the external system when the relays have settled.

Characteristics

RF Connectors – 20 BNC connectors, 16 channels and four commons.

Control Input (Ext Trig) – TTL compatible.

Control Output Data Accepted (Ready) – TTL compatible. Output goes high when relays have settled.

Channel Configuration (Software Selectable) – 1, 2, 3, or 4 groups of 4 channels. 2 groups of 8 channels. 1 group of 16 channels.

Frequency Response – Any 1 Group of 4: 3 dB at 350 MHz, decreasing to 6 dB at 500 MHz or greater. Any 1 Group of 8: 3 dB at 175 MHz or greater. Any 1 Group of 16: 3 dB at 80 MHz or greater.

Port (Channel) Isolation – 40 dB at 100 MHz.

Characteristic Impedance (Each Channel) – 50 Ω. See VSWR specification.

Rise Time (Each Channel) – 1 ns.

Voltage Standing Wave Ratio (VSWR) – Any 4 Channel Group: 1.25: 1 at 100 MHz, increasing to 1.8: 1 at 350 MHz. Any Other Combination: 1.5: 1 at 100 MHz. 2: 1 at 225 MHz.

Insertion Loss – 1 dB at 100 MHz.

Channel Delay Matching – Any Group of 4: 50 ps. Any Group of 8: 110 ps. Any Group of 16: 310 ps.

Type of Relays – 16 Form A, 4 Form "C". Pull-In Time: 3 ms. Release Time: 3 ms. Breakdown Voltage: 350 V (DC + peak AC). Series Path Resistance (End of Life): 0.5 Ω.

Peak Carry Voltage – Unterminated: 40 V maximum. 50 Ω Terminated: 12.5 V maximum.

Peak Contact Current – 0.25 A maximum.

Peak Switching Voltages – Unterminated: 15 V maximum. 50 Ω Terminated: 3.73 V maximum.

Peak Switching Current – 0.01 A maximum.

SI 5010

- Command Buffer for Controller-Free Operation
- Software Configurable as:
  - 1 Group of 16 Channels
  - 2 Groups of 8 Channels
  - 4 Groups of 4 Channels
- 350 MHz Bandwidth in 4-Channel Configuration
- External Handshake Lines
- Built-In Time-of-Day and Pacing Clock
- Two Wide Size

An excellent choice to extend the capabilities of benchtop ATE or rack and stack systems.

ORDERING INFORMATION

SI 5010
Programmable Scanner (070-3721-00) **$2,750**
Includes: Instruction Manual; Instrument Interface Guide; Reference Guide.

WARRANTY-PLUS SERVICE OPTIONS
Opt. M7 – Calibration Service ..... **+$115**
Opt. M9 – Repair Protection ..... **+$160**

PROBES
Differential – 100 MHz, Active Differential, 6 ft. Order P6046 .. **$2,195**
50 Ω Divider – 50 Ω inputs. 9 GHz, 0.15 pF/500 Ω, 1 m. Order P6150 ..... **$995**
Current –
(AC only) 120 Hz-60 MHz, 7.5 A peak. Order P6021 ..... **$545**
(AC only) 935 Hz-120 MHz, 3 A peak. Order P6022 ..... **$595**
(DC & AC) DC-50 MHz System. Order AM503S **$2,595**
Includes: AM503A, Current Probe Amplifier, A6302 Current Probe, and TM502 Mainframe.

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

GPIB IEEE-488 — The SI 5010 complies with IEEE Standard 488.1-1987, and with Tektronix Standard Codes and Formats.

Audio Analysis

CONTENTS

General Information....343
SG 5010 Oscillator....344
SG 505 Oscillator....344
AA 5001 Distortion Analyzer....346
AA 501A Distortion Analyzer....346

Audio and Communication Measurement Fundamentals

Most measurements made below 100 kHz in the audio/communications world fall into two broad categories; level (amplitude) and non-linearity (distortion).

Level measurements include: frequency response, gain/loss, noise level, or signal-to-noise (S/N) ratio, power, and crosstalk/separation/isolation.

Non-linearity measurements include: total harmonic distortion (THD, THD+N), individual distortion, intermodulation distortion (IMD; standards include SMPTE, DIN, CCIF).

Most of these measurements are stimulus/response measurements; that is, a suitable stimulus is applied to the input of the device under test and the measurement is then made at the output. Some of these are single measurements (power, noise level, distortion), some are the ratio of two single-point measurements (gain/loss, signal-to-noise ratio, crosstalk/separation/isolation), and many are sets of single point measurements (frequency response, THD vs frequency, IMD vs level, power vs frequency, crosstalk vs frequency, etc.). It is very common to graph the results of the sets of measurements for further interpretation and analysis. With GPIB instruments this can be done relatively automatically.

The stimulus source required for all except IMD measurements is a "simple", low-distortion sinewave oscillator. The signal is simple to describe mathematically; but it is not simple to design and build sinewave sources whose undesired output products are more than 100 dB below the desired sinewave output. Tektronix makes the best low frequency sinewave oscillators in the world in the SG 505 and the programmable SG 5010.

IMD testing requires two sinewaves combined together; we have also done that best for SMPTE and DIN IMD testing in the SG 505 Options 01 and 02. The SG 5010 goes a big step further by making it possible, for the first time, to do CCIF IMD testing as easily as other audio measurements.

Level (amplitude) measurements are typically made with an AC voltmeter. A digital multimeter is built into the AA 5001/AA 501A, removing the need for a separate voltmeter.

Important considerations include bandwidth (must be at least 20 Hz to 20 kHz and preferably extends to several hundred kHz), detector response type (RMS preferred, but many older and less expensive instruments use average-responding-RMS calibrated), sensitivity (must extend down toward the microvolt region for noise measurements on state-of-the-art devices), input circuitry (must be true differential – balanced for rejection of common-mode noise, so that you can use that sensitivity), and the human factors considerations of display type – analog meter vs digital numeric readout, manual vs autoranging, etc. The availability of filters to control the instrument's bandwidth, or sensitivity through the bandwidth, is important for rejection of extraneous noise and to provide noise measurements which correlate well with human perceptions of noise.

Whether the application is in the calibrating/ verifying of low frequency oscillator products, baseband testing of satellite, microwave, and wire-line communications equipment, manufacturing of consumer audio products, or maintaining broadcast stations and recording studios, signal quality is of the utmost importance.

Audio Analysis

AA 5001, SG 5010, AA 501A, SG 505

VOCABULARY

Much of the special vocabulary used by audio and communication workers relates to the dB (decibel). Since level measurements are common from several tens of volts on down to microvolts, the industry long ago standardized on using dB to express both absolute levels and ratios of signals. Frequency response is always "±X dB" from the midband level; signal-to-noise ratio is "minus X dB" or "X dB down". In the broadcasting, recording, and satellite/microwave/telephone industries, absolute levels are also referred to in dB rather than volts or watts. The most common reference is one milliwatt. Levels referred to one milliwatt are expressed in dBm. Watts are clearly a power unit, but most level measuring instruments are voltmeters (not wattmeters) and are not sensitive to circuit impedance. They must be calibrated for some particular value of impedance if they are to display dBm (power) even though they really measure voltage, and 600 Ω is the most common circuit impedance in broadcasting/recording (150 Ω is also frequently used).

Our AA 501A and AA 5001 work this way in dBm mode; they assume they are connected across a 600 Ω circuit. A purist would probably label our dBm mode (and other manufacturers, too) as dBu, or dB relative to 0.7745 volts. This is the voltage produced by one milliwatt being dissipated in 600 Ω, so there is no difference between dBm and dBu if you are connected across a 600 Ω circuit.

Most of the other special vocabulary you're likely to encounter, will be in the area of standard industry specifications. SMPTE is the Society of Motion Picture and Television Engineers; DIN is the Deutsches Institut Für Normalung, a German-based standards organization. CCIF and CCIR are the initials of the French names for Swiss-based standards groups in the communication fields. IEC is the International Electrotechnical Commission, also European. CCITT is another set of French initials for a standards group in the telephone industry in Europe. IHF is the Institute of High Fidelity Manufacturers, dealing with consumer audio products. SINAD stands for the ratio of (signal + noise + distortion)/(noise + distortion), and is a technique (requiring a distortion analyzer) for measuring the sensitivity of two-way mobile radio receivers; it is promulgated by the EIA (Electronic Industries Association). The Tektronix Audio/Communications test instruments either can make measurements in accordance with certain of these "standards" specifications or we specify our own performance according to some of their specifications.

Whether the application is in the calibrating/verifying of low frequency oscillator products, base-band testing of satellite, microwave, and wire-line communications equipment, manufacturing of consumer audio products, or maintaining broaDCast stations and recording studios, signal quality is of the utmost importance. Measurement standards and techniques such as those defined by SMPTE, DIN, and CCITT dictate that testing of these signals requires highly accurate and sensitive state-of-the-art equipment.

Audio Oscillators

Precision Audio Oscillator for R and D, Manufacturing and Service.

SG 5010/SG 505

- 10 Hz to 100 kHz Sine Wave Output
- Ultra–Low Distortion: 0.0008% THD (Typically 0.0003%)
- Floating or grounded Output
- 600 Ω Source Impedance
- Vernier Frequency Control
- Fully Balanced Output to 28 dBm (SG 505 Opt. 02)
- Selectable Source Impedance (SG 505 Opt. 02)
- Intermodulation Test Signal (Opt. 01 and 02)

SG 5010/SG 505/SG 505 Opt. 2

SG 5010/SG 505

The SG 5010 and SG 505 Oscillators generate an ultra-low distortion sine wave from 10 Hz to 163.8 kHz (SG 505 to 100 kHz) with less than 0.0008% and 0.0032% THD respectively. The THD is typically less than 0.0003% in the 20 Hz to 20 kHz range.

The SG 5010 offers the full benefits of TM 5000 configurability, GPIB compatibility, and compliance with Tektronix Standard Codes and Formats. It generates five waveforms: sine wave, square wave, SMPTE/DIN intermodulation test signal, CCIF intermodulation test signal, and sine wave burst. All of these signals may be swept in frequency or amplitude. The five-digit LED display indicates parameter values and units plus indicators for the remote and addressed states. Three source impedances are selectable and the output signal can be grounded or floating, balanced or unbalanced. Output amplitude is programmable from 0.2 mV to 21.2 V peak equivalent V RMS, supplying up to 28 dBm into a 600 Ω load.

On the SG 505, a FREQUENCY Hz dial provides frequency adjustment within each band. A FREQ VERNIER control permits extremely fine frequency adjustment within each band. A Frequency adjustment (to ≤ ±1%) range. Distortion is less than or equal to 0.0008% from 20 Hz to 20 kHz. An OUTPUT LEVEL switch, calibrated in 10 dBm into a 600 Ω load, selects eight level steps at the OUTPUT. The SYNC OUT connector provides approximately 200 mV RMS fixed amplitude and ground-referenced sin wave signal at the same frequency as the OUTPUT.

The SG 505 Option O1 adds an intermodulation test function. The intermodulation test function. The intermodulation Test Signal pushbutton mixes an intermodulation test function. The Intermodulation Test Signal pushbutton mixes an internally selectable 60 or 250 Hz sine wave with the normally selected frequency in a 4:1 amplitude ratio. The composite peak-to-peak amplitude is calibrated to be identical with the peak-to-peak amplitude is calibrated to be identical with the peak to peak amplitude of the OUTPUT signal in the normal oscillator mode.

The SG 505 Option 02 adds the Option 01 (intermod) and changes the SG 505 to have a balanced output with an amplitude range of +22 dBm to –68 dBm; the variable attenuator provides a continuous adjustment from CAL.

A front panel control selects a source resistance of 600, 150,or 50 Ω.

Characteristics (SG 505)

MAIN OUTPUT

The following characteristics are common to the standard SG 505 and SG 505 with Opt. 01.

Frequency Range – 10 Hz to 100 kHz in four overlapping bands. Accurate within 3% of dual setting (with Vernier at center). Vernier Range is at least ±1% of frequency setting.

Calibrated Output – Selectable from +10 to –60 dBm into 600 Ω in eight 10 dB steps. Accurate to within 0.2 dB at 0 dBm and 1 kHz. Step accuracy is 0.1 dB/10 dB step. An uncalibrated control provides continuous variation from at least +2.2 dB to <–10 dB from calibrated positon.

Amplitude Response – Level flatness ±0.1 dB from 10 Hz to 20 kHz (1 kHz ref); within 0.2 dB from 20 to 100 kHz (excluding >–60 dB output-level range).

Harmonic Distortion – <0.0008% (–102 dB) THD from 20 Hz to 20 kHz (typically 0.0003%); 0.0018% (–95 dB) THD from 10 to 20 Hz, and from 20 to 50 kHz 0.0032% (–90 dB) THD from 50 to 100 kHz (RL ≥600 Ω).

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

GPIB IEEE-488 — The SG 5010 complies with IEEE Standard 488.1-1987, and with Tektronix Standard Codes and Formats.

Audio Oscillators

SG 5010
SG 505

Output Impedance – 600 Ω ±2%; floating or grounded through ≈30 Ω. Output impedance does not change with Output On/Off selection. Maximum floating voltage ±30 V peak.

Maximum Output Voltage – At least 6 V RMS open circuit; 3.16 V RMS (+10 dBV or + 12.2 dBm) into 600 Ω.

SYNC OUTPUT Signal – 200 mV RMS ±20% sine wave to 20 kHz, at least 120 mV RMS at 100 kHz.

Frequency – Same as main output.

Impedance – Nominally 1 kΩ, ground referenced and isolated from main output,

SG 505 WITH OPTION 01 IM TEST SIGNAL

LF Frequency – Internally selectable 60 Hz (±1 Hz) or 250 Hz (±3 Hz).

Main Output – Composite p-p output within 0.2 dB of normal oscillator mode output.

Residual IMD – <0.0005% from 2.5 to 10 kHz.

Sync Output – LF signal component only, 200 mV RMS ±20%.

SG 505 WITH OPTION 02 BALANCED OUTPUT PLUS IM

Calibrated Balanced Output – Selectable from +22 to –68 dBm into 600 Ω in ten 10 dB steps. Accurate to within 0.2 dB at +22 dBm and 1 kHz. Step accuracy is ±0.1 dB/10 dB step or 20 dB step change. An uncalibrated control provides continuous variation from <–10 to +0.3 dB from calibrated position.

Harmonic Distortion – <0.0008% (–102 dB) THD from 20 Hz to 20 kHz (typically 0.0003%); 0.0018% (–95 dB) THD from 10 to 20 Hz, and from 20 to 50 kHz; 0.0056% (–85 dB) THD from 50 to 100 kHz (RL ≤600 Ω).

Output Impedance Selectable – 600 Ω ±2%, 150 Ω ±2%, or 50 Ω ±3% floating or grounded through ≈30 Ω. Output impedance does not change with Output On/Off selection. Impedance to CT is 1/2 the selected impedance. Maximum floating voltage ±25 V peak.

Maximum Output Voltage – At least 21 V RMS open circuit; 19.45 V RMS (+28 dBm) into 600 Ω from 50 Ω.

Balance – ≤0.5% mismatch of output open-circuit voltages referenced to CT for f ≤20 kHz with output grounded.

Characteristics (SG 5010)

AVAILABLE FUNCTIONS

Sine wave, square wave, SMPTE/DIN 4:1, SMPTE DIN 1:1, CCIF, Sine-Wave Burst, IHF Burst (±20 dB or OFF between bursts), External Input (Amplifier Mode).

FREQUENCY RANGE AND ACCURACY

Sine Wave, Sine-Wave Burst – SMPTE/DIN: 10 Hz to 163.80 kHz ±0.01%. CCIF Center Frequency: 2.500 to 163.80 kHz ±0.01%. Square Wave: 10 Hz to 16.380 kHz ±0.01%.

Resolution in Above Functions – 10.00 to 163.80 Hz: 0.01 Hz; 163.9 Hz to 1.6380 kHz: 0.1 Hz; 1.639 to 16.380 kHz: 1.0 Hz; 16.39 to 163.80 kHz: 10.0 Hz.

SMPTE Lower Tone, CCIF Offset From Center Frequency – Selectable From: 40, 50, 60, 80, 100, 125, 250, 500 Hz, all ±2%.

Sine Distortion (Load 600 Ω THD Including 2nd Through 5th Harmonics) –
20 Hz to 20 kHz: 0.001% (–100 dB).
20 to 50 kHz: 0.0032% (–90 dB).
10 to 20 Hz and 50 to 100 kHz: 0.01% (–80 dB).
100 to 163.8 kHz: 0.032% (–70 dB) any individual harmonic.

Sine Flatness – 20 Hz to 20 kHz: 0.05 dB; 10 Hz to 163.8 kHz: 0.2 dB.

Square-Wave Rise Time – 1.5 µs ±10%.

Burst Range – 1 to 65535 cycles On. 1 to 65535 cycles Off. Off Level either 20 dB or zero. All switching at sine-wave zero crossing. Triggered, gated, or free-running burst modes available.

OUTPUT LEVEL RANGE AND ACCURACY

Balanced – Into Open Circuit: 200 µV to 21.2 V RMS. Into 600 Ω: –72.45 to +28.05 dBm.*1

Unbalanced – Into Open Circuit: 200 µV to 21.2 V RMS. Into 600 Ω: –72.45 to +22.05 dBm.*1

Resolution – 0.05 dB in dBm mode, 0.25% or better in volts mode.

Level Accuracy (Sine Wave) – 20 Hz to 20 kHz ±2% (0.2 dB). 10 Hz to 163.8 kHz ±3% (0.3 dB).

OUTPUT IMPEDANCE AND CONFIGURATION

50 Ω ±3%, 150 Ω ±2%, or 600 Ω ±1%, balanced or unbalanced, floating or grounded.

External Input – A floating single-ended input is provided for accessing the variable-gain stage and high-level output amplifier, enabling the use of custom test signals. Input impedance is 20 kΩ; a 2 V RMS input (2.83 V peak maximum) provides a calibrated output.

SYNC OUTPUT

A ground referenced TTL-compatible signal is provided that allows stable oscilloscope display of all functions. In sine and square wave modes, the output is at the signal frequency. In the IM modes, the sync output is at the lower or offset frequency. In both burst modes, the sync signal follows the burst envelope.

SWEEP MODE

Linear or logarithmic sweep of amplitude or frequency in any function. Sweep is composed of discrete steps. The following sweep functions are programmable via GPIB or from the front panel: swept parameter (frequency or amplitude), linear or log sweep, number of steps up to 99, time per step from 0.1 to 25 s, start frequency or voltage, and stop frequency or voltage. Start and stop frequencies or voltages can be anywhere within the range of the generator, and sweep direction can be upward or downward. Pen lift and ramp outputs are available for interface to an analog plotter.

STORED SETUPS

Ten different complete front-panel setups can be stored in the nonvolatile internal memory and recalled from front-panel pushbuttons or via the GPIB. Additionally, the front-panel settings at power down are retained and used at power up.

PROGRAMMABILITY

All functions, parameters, and modes can be controlled over the GPIB using simple English-like commands. All settings can be interrogated, with the resulting response usable as a command to return the instrument to that setting (Learn mode). The GPIB address can be displayed and changed from the front panel.

POWER REQUIREMENTS

SG 5010 – Occupies two compartments of a TM 5000 mainframe.

SG 505 – Occupies one compartment of a TM 500 or TM 5000 mainframe.

*1 R_s = 50 Ω. For R_s = 150 Ω, subtract 1.25 dBm; for R_s = 600 Ω, subtract 5.35 dBm.

ORDERING INFORMATION

SG 5010
Programmable Oscillator **$4,795**
Includes: Instruction Manual (070-4331-00), Instrument Interface Guide (070-4790-00), Reference Guide (070-4330-00).

SG 505
Oscillator **$1,350**
Includes: Instruction Manual (070-2823-00).

SG 505 OPTIONS
Opt. 01 – IM Test Signal ..... **+$225**
Opt. 02 – Balanced Output plus IM. Includes: Cable assembly for sync output (175-1178-00). ..... **+$730**

WARRANTY-PLUS SERVICE OPTIONS
Opt. M7 – Calibration Service
SG 5010 ..... **+$260**
SG 505 ..... **+$115**
Opt. M9 – Repair Protection
SG 5010 ..... **+$305**
SG 505 ..... **+$225**

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

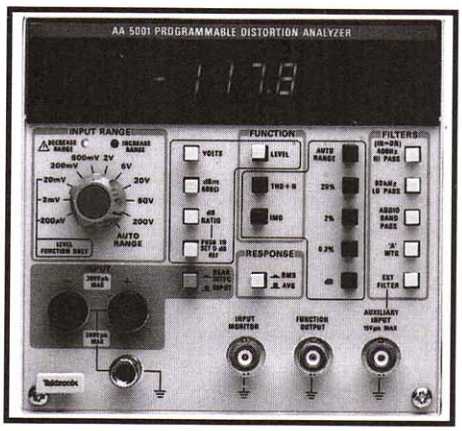
GPIB IEEE-488 — The SG 5010 complies with IEEE Standard 488.1-1987, and with Tektronix Standard Codes and Formats.

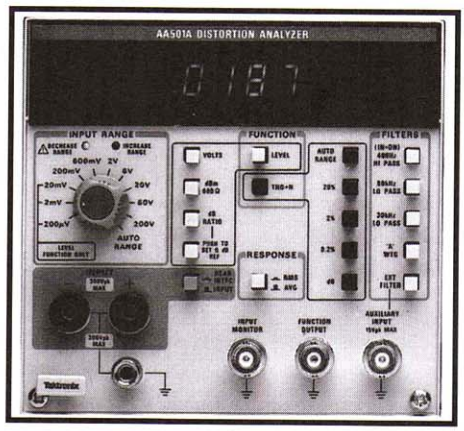
Distortion Analyzers

Automatic Measurements for your analysis of audio signals.

AA 5001/AA 501A

- Fully Automatic: No Level Setting, Tuning, or Nulling
- Level, Total Harmonic Distortion, and dB Ratio Measurements
- Total System Harmonic Distortion plus Noise (THD+N) 0.0025% (with Companion SG 5010/SG 505 Oscillators)
- Residual Noise ≤3.0 μV
- Digital Readout plus Analog-Like Bar Graph for Peaking and Nulling
- IMD to SMPTE, DIN, and CCIF (Standard with AA 5001; Opt. 01 Required for AA 501A)





AA 5001/AA 501A

The AA 5001/AA 501A Distortion Analyzers provide fully automated measurement of level, total harmonic distortion plus noise (THD+N), and intermodulation distortion (Option 01 for the AA 501A). The AA 5001 adds GPIB compatibility plus programmability.

FULLY AUTOMATIC

Automatic measurement means that once the mode is selected and the test signal is applied, the operator simply reads the accurate result on the 3-digit display. Functions such as level setting, tuning, and nulling are fully automatic.

The AA 501A Option 01 adds intermodulation distortion measurement capability conforming to SMPTE, DIN, and CCIF standards. Internal circuitry automatically identifies the signal being used and performs the measurement, making IMD measurements as automatic as harmonic distortion measurements. These capabilities are standard in the AA 5001.

ADVANCED PERFORMANCE

The AA 5001/AA 501A provides dB-ratio measurement referencing either to 774.6 mV (1 mW in 600 Ω) or to a user applied signal. The 0 dB reference memory stores the selected level, and all subsequent measurements are referenced to it. The user can choose true RMS or average response. While true RMS is generally more accurate, the averaging feature is convenient for comparison of new data with data taken on older instruments where averaging was the only mode available.

The fundamental frequency range is 10 Hz to 100 kHz, with harmonic measurements to 300 kHz. Any one of four built-in frequency-weighting filters can be switched into the signal paths for input signal preconditioning. External filters can be simply connected for special applications such as stereo pilot tone rejection, rejection of continuous tone squelch signals in mobile radio systems, or for selection of individual harmonics instead of total harmonic distortion measurements.

An Input-Monitor connector and a Function-Output connector permit oscilloscope display of the input signal or the filtered signal input used in THD+N measurement.

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

GPIB IEEE-488 — The AA 5001 complies with IEEE Standard 488.1-1987, and with Tektronix Standard Codes and Formats.

Distortion Analyzers

Characteristics

HARMONIC DISTORTION FUNCTION

Fundamental Frequency Range – 10 Hz to 100 kHz, automatically tuned to input frequency.

Distortion Ranges – Auto (100%), 20%, 2%, 0.2%, and dB (autoranging).

Accuracy – 20 Hz to 20 kHz is within ±10% (±1 dB) for harmonics ≤100 kHz. 10 Hz to 100 kHz is within +10% (+1 dB), –20% (–2 dB for harmonics ≤300 kHz. (Accuracy is limited by residual THD + N and filter selection.)

Typical Fundamental Rejection – At least 10 dB below specified residual THD + N or actual signal THD, whichever is greater.

Minimum Input Level – 60 mV (–22 dBm).

LEVEL FUNCTION

Autoranging digital voltmeter displays input-signal level in volts, dBm, or dB ratios.

Modes – Volts, dBm (600 Ω), or dB ratio with push-to-set 0 dB reference.

Level Ranges – 200 μV full scale to 200 V full scale in ten steps, manual or autoranging.

Accuracy –

Frequency	Volts	dBm or dB Ratio
20 Hz to 20 kHz	±2% (+2 counts)	±0.3 dB[*1] + 0.5% of reading
10 Hz to 100 kHz	±4% (+2 counts)	±0.5 dB[*1] +0.5% of reading

*[*1] Vi_n ≥100 μV, level ranging indicators extinguished. ±0.2 dB at 1 kHz only. Flatness is 0.1 dB, 20 Hz to 20 kHz, and ±0.3 dB, 10 Hz to 100 kHz.*

Bandwidth – ≥300 kHz.

Residual Noise – ≤3 μV (–108 dBm) with 80 kHz and 400 Hz filters, RMS response; (AA 5001, AA 501A and AA 501A (Opt. 01) ≤1.5 μV (–114 dBm) with "A" weighting filter, RMS response (standard instruments only); ≤5 μV (–104 dBm) with CCIR weighting filter, quasi-peak response (Opt. 02 instruments only).

INTERMODULATION DISTORTION FUNCTION (AA 5001 and AA501A OPT. 01)

Fully automatic SMPTE, DIN, and CCIF difference tone measurements. Minimum input level 60 mV (–22 dBm). Accuracy ±1 dB. For IM Components ≤1 kHz.

SMPTE and DIN Tests – Lower Frequency Range: 50 to 250 Hz. Upper Frequency Range: Usable from 3 to 160 kHz. Level Ratio Range: 1:1 to 4:1 (lower:upper). Residual IMD: AA 5001 ≤0.0032% (–90 dB) with 60 Hz and 7 kHz or 250 Hz and 8 kHz test tones; ≤0.0025% for AA 501A.

CCIF Difference Frequency Test – Frequency Range: Usable from 4 to 160 kHz. Difference Frequency Range: 80 Hz to 1 kHz. Residual IMD: ≤0.0018% (–95 dB) with 14 kHz and 15 kHz test tones (System specification with any SG 5010 Oscillator or passively summed SG 505 Oscillator pair).

ALL FUNCTIONS

Displays – 3 1/2-digits resolution at ≈3 readings/s.

Detection – Average or true RMS for waveforms with crest factors ≤3. (Opt. 02 replaces average detector with quasi-peak detector complying with CCIR Recommendation 468-2 and DIN 45405.

Filters – 400 Hz High Pass: –3 dB at 400 Hz ±5%; 18 dB/octave slope, at least 40 dB rejection at 60 Hz.
80 kHz Low Pass: –3 dB at 80 kHz ±5%; 18 dB/octave slope.
30 kHz Low Pass: (AA 501A only) –3 dB at 30 kHz ±5%.
Audio Bandpass: (AA 5001 only) –3 dB at 22.4 Hz and 22.4 kHz, both ±5%. Complies with CCIR Recommendation 468-2 and DIN 45405.

"A" Weighting – Meets specifications for Type One sound-level meters (ANSI S1.4, IEC Recommendation 179). Opt. 02 replaces "A" weighting filter with CCIR weighting filter complying with CCIR Recommendation 468-2 and DIN 45405.

Ext – Allows connection of external filters.

Input Type – Balanced (full differential).

Input Impedance – 100 kΩ ±2%, each side to ground.

Maximum Input – 300 V peak, 200 V RMS either side to ground or differentially. Fully protected on all ranges.

Common-Mode Rejection – ≥50 dB at 50 or 60 Hz. Typically ≥40 dB to 300 kHz.

PROGRAMMABILITY (AA 5001 ONLY)

Function – (Level or THD or IMD). Level Mode (Volts or dBm). Input Level and Distortion Ranges (Auto-range or default to range selected by front-panel switches).

Detector Type – (RMS or AVG; or RMS or Q-PK on Opt. 02).

Filter Selection – (400 Hz Hi Pass, 80 kHz Low Pass, 22.4 Hz to 22.4 kHz Band-Pass, "A" Weight (or CCIR WTG on Opt. 02, Ext Filter).

FRONT-PANEL SIGNALS

Input Monitor – Provides constant-amplitude version of signal applied to input. Output Voltage: 1 V RMS ±10% for input signals >50 mV. Source Impedance: 1 kΩ ±5%.

Function Output – Provides a scaled sample of selected function signal. Output Voltage: 1 V RMS ±3% for 1000 count display. Source Impedance: 1 kΩ ±5%.

Auxiliary Input – Provides input to detector circuit when Ext Filter button is depressed. Sensitivity: 1 V RMS ±3%=1000 count display. Impedance: 100 kΩ ±5%, AC coupled.

POWER REQUIREMENTS

AA 5001 – Occupies two compartments of a TM 5000 mainframe.

AA501A – Occupies two compartments of a TM 500 or TM 5000 mainframe.

ORDERING INFORMATION

AA 5001
Programmable Distortion Analyzer **$3,995**
Includes: Instruction Manual (070-4598-01); Instrument Interface Guide (070-4788-00); Reference Guide (070-4597-00).
Opt. 02 – CCIR/DIN (includes Intermodulation Distortion) ..... **+$450**

AA 501A
Distortion Analyzer **$3,295**
Includes: Instruction Manual (070-2958-00).
Opt. 01 – Intermodulation Distortion. ..... **+$750**
Opt. 02 – CCIR/DIN (includes Intermodulation Distortion) ... **+$1,150**

WARRANTY-PLUS SERVICE PLANS OPTIONS
Opt. M7 – Calibration Service
AA5001 ..... **+$170**
AA501A ..... **+$45**
Opt. M9 – Repair Protection
AA5001 ..... **+$245**
AA501A ..... **+$35**

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

GPIB IEEE-488 — The AA 5001 complies with IEEE Standard 488.1-1987, and with Tektronix Standard Codes and Formats.

Amplifiers
Signal Conditioners

Extend the capabilities of any oscilloscope.

AM 502

- Differential Gain
- 2% Gain Accuracy
- 100 dB CMRR to 50 kHz
- Selectable Upper and Lower –3 dB Points
- Adjustable DC Offset
- DC to 1 MHz Maximum Bandwidth

AM 501

- ± 40 V, 50 mA Output
- Open-Loop Gain 10,000
- 50 V/µs Slew Rate
- Symmetrical Differential Design
- Optional Circuit Board to Customize Function

AM 502

Signal Conditioners

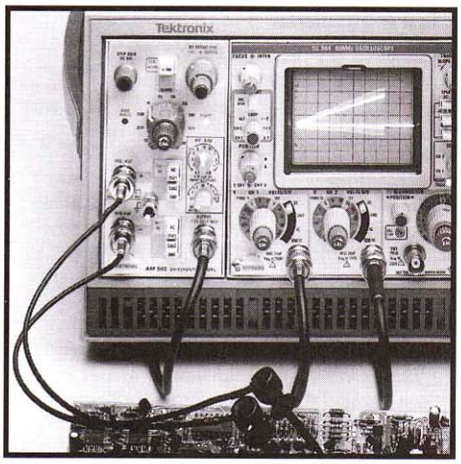
TM 500 Signal Conditioners offer unique capabilities for solving electrical measurement and analysis problems. The compact portability and plug-in flexibility of these modules are applicable to a broad range of measurement needs including: preamplification of low-level signals, addition or removal of DC offset, integration, differentiation, filtering, summing of multiple signals, impedance transformation, level conversion (to 80 V peak-to-peak), current probe amplification and a unique time-interval to voltage converter.

AM 502 Differential Amplifier/Comparator

The versatile AM 502 lets you control gain, DC offset, and low and high frequency response for maximum rejection of unwanted signals. The AM 502 is particularly suited to sensor signal amplification or applications where one side of the measured voltage is not ground. For example, the AM 502 can amplify small voltage drops across resistors to monitor current flow to the bandwidth of the amplifier. Adjustable DC offset before attenuation/amplification allows high amplification even when low-level signals have a DC component. Adjustable filtering (with differential amplification) permits the AM 502 to emulate different loop filters on the differential phase comparator outputs in a phase locked loop design.

TRUE VS. PSEUDO DIFFERENTIAL

The AM 502 is ideal for driving oscilloscopes, chart recorders, or other instruments that do not have differential inputs. One commonly used oscilloscope technique for differential measurements is the Add/Invert function (CH 1 – CH 2). In addition to tying up both main inputs, this technique has limited dynamic range since sensitivity decreases with increasing common mode voltage.



AM 502 provides differential comparator capability to scopes with single-ended inputs.

True differential amplifiers such as the AM 502 isolate small differential voltages riding on common mode voltages which are orders of magnitude larger.

Common mode voltages may also have a large AC component at the line or switching frequency. Differential amplifiers have matched "+" and "–" input pairs which are critical for AC common mode rejection. The AM 502 has a common mode rejection ratio of at least 100 dB up to 50 kHz. High CMRR translates to greater confidence that a measured differential voltage is not corrupted by a fluctuating common mode voltage. Matched differential probe pairs such as the P6055 are recommended as the signal path from the desired test points.

TRUE DIFFERENTIAL VS. DIGITAL PROCESSING

The AM 502 enhances the capabilities of both analog and digital storage oscilloscopes. Digital post-processing capabilities such as waveform subtraction can simulate differential measurements between two simultaneously sampled signals. However, the dynamic range of digital waveform subtraction is typically limited by sampled data resolution (such as 8-bit a/d converter results) rather than the precision of the subtraction algorithm. The AM 502 as a front-end to a digital oscilloscope insures that the digital conversion capability is applied to measuring the desired difference voltage rather than as a guard to a/d converter overflow for large common mode signals.

DC OFFSET VS. OSCILLOSCOPE POSITIONING

Alternatively, a scope's vertical position control can visually "offset" a waveform by bringing an off-screen signal into viewing range. While this apparently performs the DC offset function, its dynamic range is limited. The vertical positioning capability of most oscilloscopes is typically less than ±20 vertical divisions. The AM 502's true DC offset effectively provides thousands of vertical divisions of offset.

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

Amplifiers
Signal Conditioners

AM 502
AM 501

Characteristics (AM 502)

Gain – 100 to 100,000, 1 to 1000 in ÷100 Mode; 1-2-5 sequence; accurate within 2%. Continuously variable gain between steps in uncalibrated mode.

HF – 3 dB Point – Selectable in 9 steps (1-3 sequence) from 100 Hz to 1 MHz, Upper –3 dB point reduces to 500 kHz at 50K gain; 250 kHz at 100K gain.

LF –3 dB Point – Selectable in 6 steps (1-10 sequence) from 0.1 Hz to 10 kHz; AC coupling limits – 3 dB point to 2 Hz or less.

Variable DC Offset – At least ±1 V. Equivalent to ±100 V in ÷100 Mode.

Common-Mode Rejection Ratio – At least 100 dB, DC to 50 kHz. ÷ 100 Mode: At least 50 dB, DC to 50 kHz.

Maximum Input Bias Current – ±100 pA each input for T ≤30°C.

Maximum Voltage Drift – 100 μV/°C referred to input.

Maximum Noise – ≤25 μV (tangentially measured) referred to input.

Common Mode Voltage Range – ±5 V, ÷ 100 Mode: ±50 V.

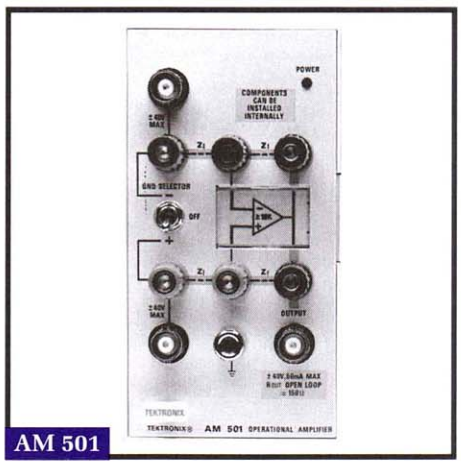
Maximum Safe Input Voltage – DC coupled: 15 V (DC + peak AC). ÷ 100 Mode DC coupled: 350 V (DC + peak AC). AC coupled: 350 V (DC +peak AC) with coupling capacitor precharged.

Input R and C – 1 MΩ paralleled by ≈ 47 pF. Input impedance can be increased to a FET input via a simple internal jumper change.

Maximum Output – ±5 V, ±20 mA, output resistance is 5 Ω or less.

Minimum Load Impedance – 250 Ω.

Over-Range – Front-panel lamp indicates most over-range conditions.



AM 501

AM 501 Operational Amplifier

The AM 501 Operational Amplifier features high input impedance (FET), high slew rate, a wide range of input and output voltage, and high output current. The output (40 V and 50 mA across 800 Ω loads) can drive many electronic and electro-mechanical applications. This high-output unit has front-panel connectors that let you change configurations by selecting feedback components. The AM 501 is easily set up for differentiation, integration, summing, offsetting, and impedance-transformation problems.

The AM 501 is ideal for quickly prototyping circuits using the versatility of high-gain operational amplifier blocks. The AM 501's V+ and V– power is supplied by any TM 500 or TM 5000 mainframe eliminating the task of securing or dedicating a dual-output power supply. When used with the accessory board described below, the AM 501 permits rapid performance comparisons of different circuit topologies.

Characteristics (AM 501)

Open Loop Gain – At least 10,000 at 60 Hz into 800 Ω load.

Unity Gain Bandwidth – At least 5 MHz into 800 Ω load.

Common-Mode Rejection Ratio – Typically >20,000:1 at 60 Hz for common-mode signals up to ±40 V.

Slew Rate – At least 50 V/μs into an 800 Ω load.

Input Bias Current – Typically <500 pA at 25°C, <2 nA at 50°C.

Drift – <100 μV/°C.

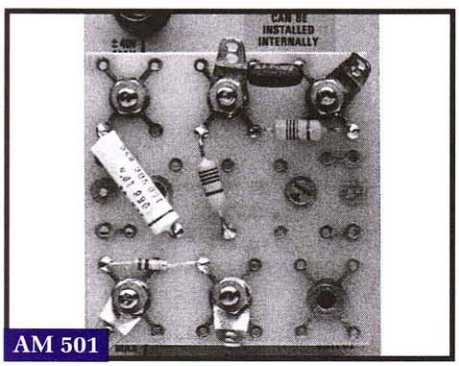
Noise – <10 μV rms.

Maximum Differential Input Voltage – 80 V.

Voltage Range – At least ±40 V into 2 kΩ.

Current Limit – At least ±50 mA.

Open Loop Output R – ≈150 Ω.



AM 501

AM 501 AUXILIARY CIRCUIT BOARD KIT

The AM 501 Auxiliary Circuit Board Kit attaches to the input and output terminal plugs on the front of the AM 501 Operational Amplifier. The kit is a pc board that has six terminal studs for attachment to the amplifier's banana jacks and is approximately 2.5 inches square. This permits the designer to build a circuit of resistors, capacitors, and other components for use in conjunction with the AM 501's input, output, or feedback circuits. With several boards, the AM 501 Op Amp circuit can be changed instantly in configuration from integrator to differentiator to amplifier.

Use of the kit does not interfere with the other connectors on the face of the AM 501.

ORDERING INFORMATION

AM 502
Differential Amplifier **$1,795**
Includes: Instruction Manual (070-1582-01).

P6135A
Differential Probe Pair **$695**

AM 501
Operational Amplifier **$995**
Includes: Instruction Manual (070-1616-01).

AM 501 Auxiliary Circuit Board Kit – Order 013-0146-00 ..... **$33**

WARRANTY-PLUS SERVICE OPTIONS

Opt. M7 – Calibration Service
AM 502 ..... **+$155**
AM 501 ..... **+$70**

Opt. M9 – Repair Protection
AM 502 ..... **+$155**
AM 501 ..... **+$125**

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

TVC 501 / AM 503A — AM 503S / A6302 Signal Conditioners

The TVC 501 provides real-time scope display of time-interval variations vs. time.

The AM503/AM503S displays current signals on any oscilloscope.

TVC 501

- Real-Time Scope Display of Time-Interval Variations vs. Time
- Time Delay, Pulse Width, and Period Measurements
- >2 Million Uninterrupted Event-by-Event Measurements/Second

AM 503A/AM 503S

- Displays Current Signals on an Oscilloscope
- DC to 50 MHz Bandwidth

A6302

- 1 mA to 20 A Current Measurement Range
- 50 A Peak Pulse Measurements
- DC to 50 MHz Bandwidth

TVC 501 Time-Interval to Voltage Converter

The TVC 501 adds three measurement functions to a scope's voltage vs. time capability: time-delay vs. time, pulse-width vs. time, and period vs. time. The TVC continuously measures the timing parameter and instantaneously generates a voltage proportional to the measurement. Conversions are performed pulse-to-pulse without averaging. The TVC 501 provides seven vertical scales from 1 µsec to 1 sec per division. Up to 30,000 divisions of offset permits small timing variations to be viewed on events with large average values.

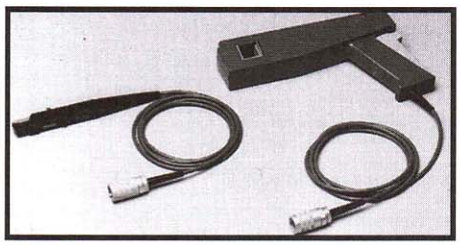
The continuous TVC output becomes another trace on a scope that can be correlated, measured, and analyzed with waveforms on other channels. Since the TVC generates voltages proportional to time-intervals, a scope can be set to trigger on timing violations such as a time-delay that exceeds a threshold or an incorrectly narrow pulse or glitch.

AM 503A/AM 503S Current Probe Amplifier

The AM 503A Current-Probe Amplifier allows display of current on any oscilloscope having 10 mV/div sensitivity, 50 Ω or 1 MΩ input, and (for performance to full band-width) at least 200 MHz bandwidth. The amplifier attenuator has 12 calibrated steps in a 1-2-5 sequence. An LED display indicates current/division. See page 446 for detailed information.

The AM 503A/A6302 and AM 503A/A6303 Current Probe Systems have a wide variety of applications from SCR and power-supply measurements to medical applications. These probes use inductive coupling to minimize interference with the circuit under test. By combining an oscilloscope, such as the SC 504, with the AM 503A/A6303 Current Probe Amplifier in a TM 500/TM 5000 mainframe, you will have a convenient and compact high-current amplification/measurement system.

A current probe package is available (AM 503S) that includes the AM 503A, A6302 (and/or A6303), and the 016-0362-02 Tool Box Module for probe storage, all in a TM 502A Power Module.



A6302 (left) and A6303 shown.

A6302 Current Probe

When a A6302 Current Probe is used with the AM 503A Current Probe Amplifier, the current range is from 1 mA to 20 A. Maximum current is 20 A (DC + peak AC). Peak pulse maximum is 50 A, not to exceed an amp product of 100 Aµs. The probe operates through inductive coupling with no electrical contact. A flick of your forefinger operates the sliding jaw in the insulated probe tip. Just put the probe tip around the conductor under test for immediate current readings.

TD

AM 503S also available within 24 hours through TekDirect. Call 1-800-426-2200

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

ORDERING INFORMATION

TVC 501 – Time-Voltage Converter. **$2,495**
See page 450 for further information.

AM 503A – Current-Probe Amplifier. **$1,550**
See page 447 for further information.

AM 503S – Current Probe System. ..... TD **$2,595**
Includes: AM 503A, A6302 (calibrated to AM 503), Tool Box, TM 502A. See page 446 for further information.

WARRANTY-PLUS SERVICE OPTIONS

Opt. M7 – Calibration Service (AM 503S) ..... **+$120**

Opt. M9 – Repair Protection (AM 503S) ..... **+$405**

A6302 – Current Probe **$775**
Includes: 5 in. Ground Lead (175-0124-01), 3 in. Ground Lead (175-0263-01), 2 Alligator Clips (344-0046-00).

Mainframes

Mainframes and Accessories

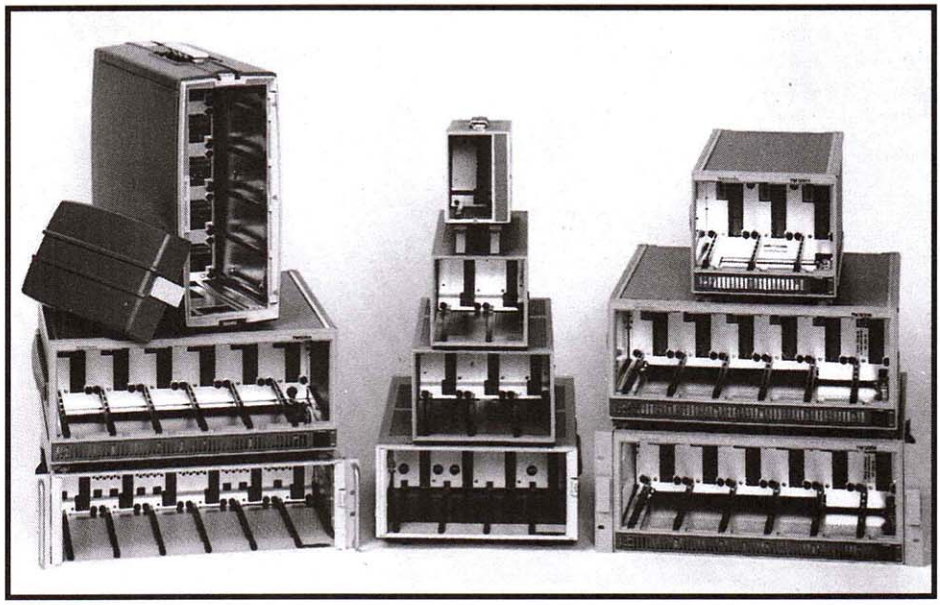
TM 500 POWER MODULE MAINFRAMES

The TM 500 power modules (mainframes) are the heart of the modular instrument architecture. Designed for maximizing benchtop, portable, and rackmount testing, these mainframes along with your choice of over 50 plug-ins from Tektronix, can be used to configure hundreds of multifunction or application specific packages.

PLUG-IN COMPATIBILITY

The TM 500 plug-in instruments operate in any of the TM 500 Series mainframes that accept instruments in combinations of up to six single-wide plug-ins. One single-wide plug-in instrument can be accommodated by the
TM 501A, or up to six instruments can be accommodated in the TM 500 bench-top (TM 506A) and rackmount mainframes. Two, three, and four-wide mainframes are also available as benchtop or Traveler mainframes, which provides for applications that require instrument portability.

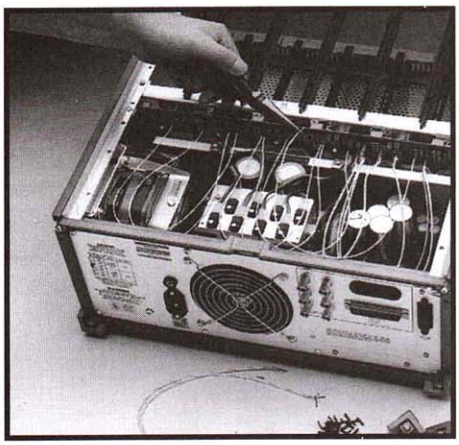
TM 5000 Power Module Mainframes provide additional flexibility and expansion into future ATE applications. These GPIB programmable mainframes will accept either TM 500 or TM 5000 plug-in instruments. The TM 5006A provides additional flexibility for Rack and Stack Systems with the Option 10 Slide Rack configuration.



CONTENTS

MAINFRAMES
General Information 351
TM 5006 353
TM 5003 353
TM 506A 354
TM 504 354
TM 503B 354
TM 502A 354
TM 501A 354
Accessories 356

TM 500 SERIES TM 5000 SERIES Mainframes



TM 5000 POWER MODULE MAINFRAMES
The TM 5000 mainframes extend the convenience of the TM 500 concept into the programmable instrument IEEE Standard 488 arena. The TM 5003 accepts up to three instruments at one time; the TM 5006A accepts up to six instruments at one time. These two TM 5000 mainframes were designed for use with the Tektronix TM 5000 line of programmable, IEEE-488 compatible test and measurement instruments, and all of the TM 500 manual plug-in instruments will also operate in these same mainframes allowing manual and programmable instruments to be mounted together in adjacent slots.

Any of the mainframes may be operated with less than a full complement of plug-in instruments installed; you don't have to have all of the compartments occupied in order to operate a TM 500 or TM 5000 system. Use only as much of the system as you need; add to it as your needs change. A blank front panel-like cover (016-0195-03) or tool box (016-0362-02) is available to cover/fill empty slots.

BENCHTOP
The seven benchtop mainframes are the TM 501A, TM 502A, TM 503B, TM 504, TM 506A, TM 5003 and TM 5006A. The TM 502A and TM 5003 are the most compact of the multiple instrument units. The TM 504, TM 506A, and TM 5006A each include a high-power compartment at the right-hand side to supply higher current levels to instruments that provide higher performance or higher output levels, such as the PS 503A, and PS 5010 Power Supplies. The TM 506A, TM 5003, and TM 5006A incorporate a quiet fan for optimum cooling. All operate from 110 or 220 VAC.

PORTABILITY
All benchtop models have carry handles and optional protective covers for portable applications. As Traveler Cases, however, were designed for superior, multi- instrument portability. It is extremely moisture and dust resistant and is designed to withstand the rigors of transport. Removing the mainframe exposes TM 500 plug-in instruments to reveal an operational electronics lab traveling in a suitcase.

RACKMOUNT
The TM 506A Option 10, and the TM 5006A Option 10 rackmount mainframes each features slide assemblies and handles, plus a higher-power fan to accommodate the higher ambient temperatures often found in enclosed racks and consoles.

REAR INTERFACE CAPABILITY
Most TM 500 plug-in modules contain a duplication of the front-panel input and output connections in the back. These interface lines are built into the rear-edge circuit card connector of each plug-in. Some plug-in modules also have additional signal or control lines that are present only at the back of the instrument. In either case, different modules may be interconnected by the user to reduce front-panel clutter or to perform functions not otherwise available. For example, the trigger output of a signal source can be interconnected to the rear input of a counter for instant frequency checks at the touch of a front-panel switch. Or, a digital multimeter and power supply may be interconnected to speed up precise voltage setups without any need to move test leads. Any module can be internally connected through the mainframe and also can be externally interfaced out the rear panel.

The mainframes can be interfaced in a variety of ways. A user can solder together the appropriate connector pins on a standard mainframe, or can order the mainframe with Option 02. Option 02 provides square-pin connectors at the rear interface between the mainframe and the plug-in instruments, plus a multi-pin connector and one or more BNC connectors mounted on the rear panel of the mainframe. To allow as much flexibility as possible, these connectors are not pre-wired. A wire kit consisting of specially prepared jumper wires and coax cables and pins is provided with the option. Then, interfacing between instruments within a mainframe and with external devices is simply a matter of connecting the appropriate terminals together.

ECONOMY
TM 500 and TM 5000 mainframes represent a most economical approach in test and measurement instrumentation. Relatively fixed packaging costs for frames, covers, primary power circuits, unregulated secondary power circuits and other items are a significant portion of the cost of a typical instrument. Since these fixed costs associated with packaging are shared by many functional instruments in the TM 5000/TM 500 lines, the cost-per-function may be lower than comparable, one- or two-function monolitic instruments. Because of its modularity, expandability, and versatility, the modular concept represented by TM 5000/ TM 500 may provide the lowest cost-per-test/measurement when you are considering multifunction usage.

The ability to upgrade to a higher-performance system without replacing the entire investment is made possible by the compatibility between the TM 500 and TM 5000 lines. Reduced cabling costs made possible by the rear-interface capability, the requirement for fewer GPIB cables for an equal number of instruments in the TM 5000 line; and the reduced space requirements for a measurement system all contribute to unprecedented economy for test and measurement.

Mainframes

TM 5006A

The TM 5006A mainframe can accept and provide power for up to six single-width TM 500 and/or TM 5000 plug-ins. The right hand compartment is a high-power compartment. The mainframe features a switching DC power supply. All DC voltages are electronically regulated. Forced-air cooling is standard.

Available options: Option 02 Rear Interface, Option 10 Rackmount, Option 12 Combination of Options 02 and 10 and Option 15 which improves EMI compatibility.

Cabinet-to-rackmount conversion kit, equipped with slide out assemble, required to convert a TM 5006A to rackmount capability. Order 040-0982-00.

Rackmount-to-cabinet conversion kit, equipped to convert a TM 5006A with rackmount configuration to cabinet style. Order 040-0983-00.

TM 5003

The TM 5003 can accept and provide power for up to three single-wide TM 500 and/or TM 5000 plug-ins. It features a switching DC power supply. All DC voltages are electronically regulated. Forced-air cooling is standard.

Available options: Option 02 Rear Interface.

Characteristics

POWER REQUIREMENTS

Line Voltage Ranges – 100, 110, 120, 200, 220, and 240 VAC (not to exceed 250 VAC on 240 VAC range); selectable via internal jumper or rear panel.

Line Frequency Range – 48 Hz to 66 Hz.

Power Consumption – TM 5006A: ~ 650 VA. TM 5003: ~ 300 VA.
(Actual power consumption depends on plug-in selection and operating modes.)

ENVIRONMENTAL

Temperature Range – Operating; 0°C to +50°C. Nonoperating: –55°C to +75°C.

PHYSICAL CHARACTERISTICS

	TM 5006A		TM 5003	
Dimensions	**mm**	**in.**	**mm**	**in.**
Width	445	17.5	230	9
Height	194	7.6	194	7.6
Depth	488	19.2	488	19.2
Weight ≈	**kg**	**lb.**	**kg**	**lb.**
Net	14.5	32	8.6	19
Shipping	20.9	46	12	26.5

TM 5006A

- Six Compartment Mainframe
- High Power Compartment
- Switching DC Power Supply
- Forced Air Cooling
- Rear Panel Interface Connections with Opt. 02
- Rackmounting Capability with Opt. 10

TM 5003

- Three Compartment Mainframe
- Switching DC Power Supply
- Forced-Air Cooling
- Interface Connections on Rear Panel Via Opt. 02

Programmable modular mainframes are ideal for benchtop or system ATE. Fast, flexible configurations with a minimum of cable connections.

ORDERING INFORMATION

TM 5006A
Power Module Mainframe **$1,195**
Includes: Instruction Manual (070-7614-00).
Opt. 02 – Rear Interface ..... **+$195**
Opt. 10 – Rackmount. Includes high-power fan ..... **+$110**
Opt. 12 – Combination Opt. 02 and Opt. 10 ..... **+$295**
Opt. 15 – Electro Magnetic Compatibility ..... **+$450**

TM 5003
Power Module Mainframe **$995**
Includes: Instruction Manual (070-2955-00).
Opt. 02 – Rear Interface ..... **+$195**

INTERNATIONAL POWER PLUG OPTIONS
Opt. A1 – Universal Euro 220 V, 50 Hz ..... **NC**
Opt. A2 – United Kingdom 240 V, 50 Hz ..... **NC**
Opt. A3 – Australian 240 V, 50 Hz ..... **NC**
Opt. A4 – North American 240 V, 60 Hz ..... **NC**
Opt. A5 – Switzerland 220 V, 50 Hz ..... **NC**
See General Customer Information Section for additional description.

WARRANTY-PLUS SERVICE OPTIONS
Opt. M7 – Calibration Service
TM5003 ..... **+$55**
Opt. M9 – Repair Protection
TM5003 ..... **+$80**

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

GPIB IEEE-488 — TM 5006A and TM 5003 comply with IEEE Standard 488.1-1987.

Mainframes

Compact modular benchtop solutions for reconfigurable test requirements.

TM 506A
- Six Compartments
- High Power Compartment
- Forced Air Cooling
- Interface Connection on Rear Panel Via Opt. 02

TM 504
- Four Compartments
- High Power Compartment
- Interface Connections on Rear Panel with Opt. 02

TM 503B
- Three Compartments
- Portable
- Convection Cooled
- Interface Connections on Rear Panel Via Opt. 02

TM 502A
- Two Compartment
- Convection Cooled

TM 501A
- Single Compartment
- Convection Cooled

TM 500 Power Module Mainframes

TM 500 plug-ins can operate in several different mainframes, including benchtop, portable, and rackmount configurations in the TM 500 line and in the TM 5000 Series mainframes. This allows hundreds of different instrumentation packages to be configured for specific tasks.

BENCHTOP

Five benchtop mainframes are available in the TM 500 series. The TM 501A is the most compact accommodating one single-width TM 500 module. Others in the series include the TM 502A, TM 503B, TM 504, and TM 506A. The TM 504 and TM 506A both include a high-power compartment at the right side to supply higher current levels. The TM 506A incorporates a quiet fan for maximum cooling. All benchtop models have feet, tilt-bails, and handles, and operate from 110 to 220 VAC.

RACKMOUNT

TM 506A has a slide assembly and handles, plus a higher-power fan to accommodate higher ambient temperatures.

TM 506A

The TM 506A mainframe accepts up to six different TM 500 plug-ins, providing a complete test station with one power cord. The right hand compartment is a high-power compartment. Forced air cooling is standard. Like most TM 500 mainframes, the TM 506A is available with the Option 02 which allows rear interfacing of different modules, reducing front panel clutter.

TM 504

The TM 504 mainframe accepts up to four single width TM 500 plug-ins. Each TM 504 comes equipped with front panel switch, tilt bail, and a handle. The right hand compartment is a high-power compartment.

TM 503B

The TM 503B accepts up to three, single width TM 500 plug-ins. This light weight, portable, benchtop mainframe includes a tilt bail handle and rear panel power entry, switch, and line selector assembly.

TM 502A

The New TM 502A accepts up to two single width TM 500 plug-ins. This lightweight, portable, benchtop mainframe includes a tilt bail handle and rear panel power entry, switch, and line selector assembly. An optional Toolbox plug-in (Opt. 13) is available.

TM 501A

The TM 501A is our smallest and most portable mainframe designed for use with one single width TM 500 plug-in. TM 500 Series instruments are interchangeable in seconds, so you can use one type plug-in instrument for one test, then use another for a completely different application.

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

Mainframes

Characteristics

POWER REQUIREMENTS

Line Voltage Ranges – 100, 110, 120, 200, 220, and 240 VAC (not to exceed 250 VAC on 240 VAC range); selectable via internal jumper or rear panel.

Line Frequency Range – TM 506A, TM 504: 48Hz to 66Hz. TM 503B, TM 502A, TM 501A: 48Hz to 400Hz.

Power Consumption – TM 506A: ~300 VA. TM 504: ~460 VA. TM 503B ~250 VA. TM 502A, TM 501A: ~120 VA
Actual power consumption depends on plug-in selection and operating modes.

ENVIRONMENTAL

Temperature Range – Operating; 0°C to +50°C. Nonoperating: –55°C to +75°C.

PHYSICAL CHARACTERISTICS

	TM 506A		TM 504		TM 503B		TM 502A		TM 501A	
Dimensions	**mm**	**in.**	**mm**	**in.**	**mm**	**in.**	**mm**	**in.**	**mm**	**in.**
Width	445	17.5	305	12	214	8.4	145	5.7	96.7	3.87
Height	194	7.6	152	6	140	5.5	140	5.5	156	6.25
Depth 19.2	488	19.2	508	20	452	17.8	407	16.6	416	16.6
Weight ≈	**kg**	**lb.**	**kg**	**lb.**	**kg**	**lb.**	**kg**	**lb.**	**kg**	**lb.**
Net	14.5	32	8.4	18.5	4.7	10.3	4.0	8.75	239	5.4
Shipping	20.9	46	11.2	24.5	7.45	16.3	6.75	14.75	5.22	11.4

ORDERING INFORMATION

TM 506A
Power Module Mainframe **$795**
Includes: Instruction Manual (070-6929-00).
Opt. 02 – Rear Interface ..... **+$195**
Opt. 10 – Rackmount. Includes high-power fan. ..... **+$110**
Opt. 12 – Combination Opt. 02 and Opt. 10. ..... **+$260**

CONVERSION KITS
Cabinet-to-Rackmount Conversion Kit – Equipped with slide-out assembly to convert TM 506A to rackmount capability. Order 040-0982-00 ..... *1
Rackmount-to-Cabinet – Equipped to convert TM 506A with rackmount configuration to cabinet style. Order 040-0983-00 ..... **$135**

TM 504
Power Module Mainframe **$780**
Includes: Instruction Manual (070-1716-01).
Opt. 02 – Rear Interface ..... **+$130**

TM 503B
Power Module Mainframe **$495**
Includes: Instruction Manual (070-7808-00).
Opt. 02 – Rear Interface ..... **+$75**

TM 502A
Power Module Mainframe **$395**
Includes: Instruction manual (070-6502-00)
Opt. 13 – Includes Plug-in Toolbox ..... **+$80**

TM 501A
Power Module Mainframe **$625**
Includes: Instruction Manual (070-7613-00).

INTERNATIONAL POWER PLUG OPTIONS
(TM 506A, TM 503B, TM 502A, TM 501A only)
Opt. A1 – Universal Euro 220 V, 50 Hz ..... **NC**
Opt. A2 – United Kingdom 240 V, 50 Hz ..... **NC**
Opt. A3 – Australian 240 V, 50 Hz ..... **NC**
Opt. A4 – North American 240 V, 60 Hz ..... **NC**
Opt. A5 – Switzerland 220 V, 50 Hz ..... **NC**
See General Customer Information Section for additional description.

WARRANTY-PLUS SERVICE OPTIONS
Opt. M7 – Calibration Service
TM 506A ..... **+$35**
TM 504 ..... **+$35**
TM 502A ..... **+$35**
TM 501A *1
Opt. M9 – Repair Protection
TM 506A ..... **+$100**
TM 504 ..... **+$80**
TM 502A ..... **+$80**
TM 501A *1

AUXILIARY PRODUCTS
See next page for Auxiliary Instruments.

[1]Contact your local Tektronix representative for price information.

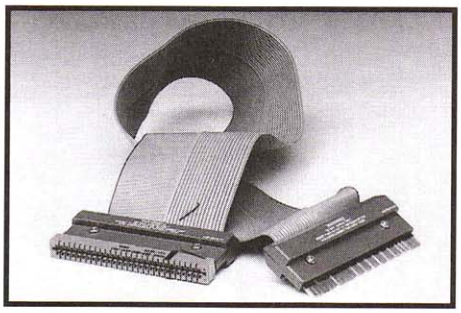
To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

Accessories

Auxiliary instruments, accessories, and flexible plug-in extender cables.

ACCESSORIES

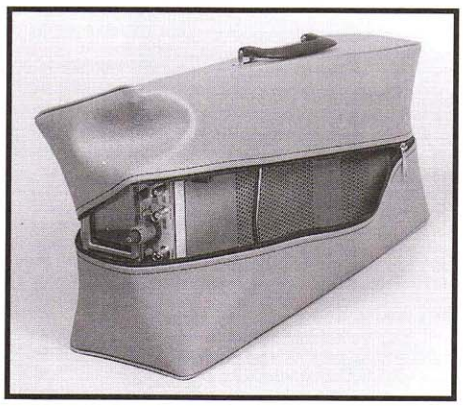
- Extension Cable
- Rain Covers
- Tool Box
- Protective Front Cover
- Mainframe Plug-in Retainers
- Accessory Pouch
- Instrument Carts
- Blank Plug-in Panel
- Rear Interface Data Book



Standard Extension Cable

Extension Cable

Designed to couple a TM 500 or TM 5000 Plug-in with the mainframe rear interface or GPIB board connections outside the mainframe for calibration and/or Customer Plug-in design.

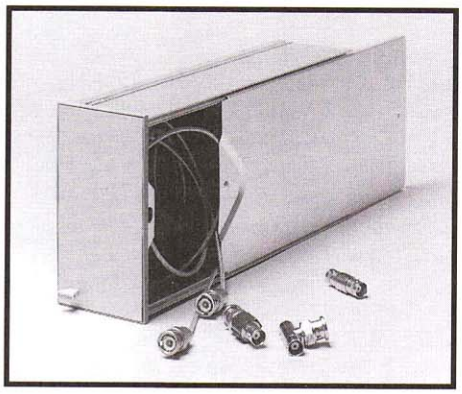


Rain Covers

These soft, weather-proof vinyl-coated Rain Covers come in sizes for TM 503B, TM 504, and the PFG 5105, AFG 5102, and other TM 5000 monolitic packages.

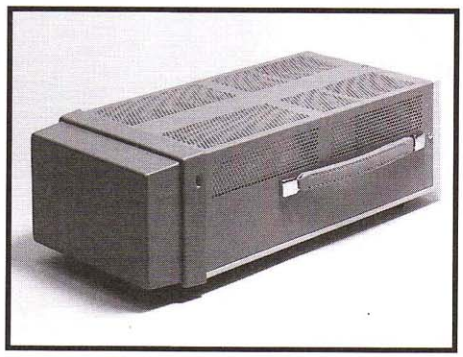
TM 500 Traveler Case

Luggage-type carrying cases are molded of high-strength glass-epoxy. They are 610 mm long; 216 mm thick; 445 mm high, (24 in. long by 8.5 in. thick by 17.5 in. high) and weights ≈ 14 lbs. empty.



Plug-in Toolbox

The plug-in toolbox provides space within your TM mainframe for storing probes, cables, "tees", accessories, and small tools. Inside dimensions: 250 mm long x 51 mm wide x 106 mm high (9-7/8 x 2 x 4-1/4 in.).

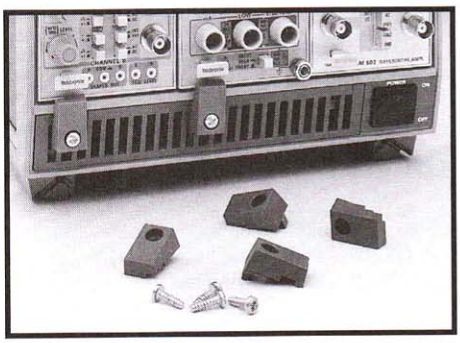


Protective Front Cover

A snap-on front cover, molded of high-impact plastic, is available for the TM 503B and TM 504 mainframes.

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

Accessories



Mainframe Plug-in Retainers

A mainframe Retainer Bar Kit is available for the TM 504 or RTM 506 to secure plug-ins; each has a separate kit, 020-0548-00 and 020-0549-00 respectively. Initial installation requires replacement of an existing bottom member of the mainframe with a new part supplied in the kit. Thus providing a mechanism for securing the plug-ins. TM 506A, TM 503B, TM 502A, TM 5003, and TM 5006A use Retainer Clips.

Blank Plug-in Panel

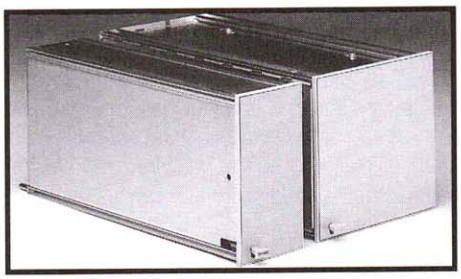
When operating TM 500/TM 5000 instruments with less than the full complement of plug-ins, the blank plug-in panel can be used to cover unused compartments.

Lab Instruments Carts

The Lab Instrument Carts accept all TM 5000/TM 500 mainframes that are up to four plug-ins wide, or an oscilloscope. See Cart Section for additional information.

Rear Interface Data Book

The Rear Interface Data Book provides diagrams and related interface information for most of the TM 5000/TM 500 plug-ins.



Custom Plug-in Kits

SINGLE COMPARTMENT WITH POWER SUPPLY BOARD (040-0803-02)

The kit includes parts and a pre-etched circuit board layout for (1) a ground-referenced positive and negative supply, capable of 7 to 20 V at up to 400 mA, and (2) a ground-reference supply, nominally 5 V, not adjustable, with up to 1 amp current capability. The circuit board includes the edge-connector interface and has about 30 square inches of 0.1" grid perforated board with plated holes for circuit development.

SINGLE COMPARTMENT WITH DEVELOPMENT BOARD (040-0652-05)

This kit comes without the power supply components or the pre-etched power supply circuit. The board includes the edge-connector interface and has about 35 square inches of board development area.

SINGLE COMPARTMENT WITHOUT BOARD (040-0821-03)

This kit comes without a board for applications where custom circuit boards are fabricated.

DUAL COMPARTMENT WITH DEVELOPMENT BOARDS (040-0754-07)

This kit has two development boards (30 and 35 square inches of development area) for applications requiring additional power, circuit area, or front panel space.

ORDERING INFORMATION

CABLES

Extension Cable – For TM 500/TM 5000 Mainframes.
Standard Cable. Order 067-0645-02 ..... **$470**

GPIB Extender Cable – Order 067-0996-00 ..... **$235**

GPIB Interconnecting Cables –
(0.5) Order 012-1015-00 ..... **$85**
(2m) Order 012-0630-01 ..... **$120**
(2m) Double Shielded. Order 012-0630-03 ..... **$125**

RACKMOUNT KITS

TM 506A/TM 5006A – Order 040-0982-00 ..... *1

Rackmount to Cubix Kit –
TM 506A/TM 5006A. Order 040-0983-00 ..... **$135**

TM 5003 – Order 040-1257-00 ..... *1

COVERS

Front Panel Cover – Snap-on.
(TM 503B) Order 200-3554-00 ..... **$29**
(TM 504) Order 200-1727-00 ..... **$20**
(TM 506) Order 200-1728-00 ..... **$24**
(TM 5003) Order 200-3252-00 ..... **$11.25**

Rain Covers – For TM 503B, TM 504, PFG 5105, AFG 5102, TM 5000. Order 016-0621-00 ..... **$45**

ADDITIONAL ACCESSORIES

Rear Interface Kits –
1-3 wide Mainframes. Order 020-1611-01 ..... *1
4-6 wide Mainframes. Order 020-1746-00 ..... *1

Mainframe Retainer Bar Kit – For TM 504 and RTM 506.
(TM 504) Order 020-0548-00 ..... **$65**
(RTM 506) Order 020-0549-00 ..... **$115**

Retainer Clips –
TM 506A, TM 5003, TM 5006A. Order 354-1085-00 ..... *1
TM 502A, TM 503B. Order 407-3658-00 ..... **$1.45**

Accessory Pouch – Order 016-0351-00 ..... **$37**

Blank Plug-in Panel – Order 016-0195-05 ..... **$47**

Plug-in Toolbox – Order 016-0362-02. ..... **$90**

Rear Interface Data Book – Order 070-2088-04 ..... **$33**

Travel/Carrying Case – TM 503B. Order 016-0565-01 ..... **$920**
TM 5000 Monolithic Packages. Order 016-0565-01 ..... **$920**
TM 504. Order 016-0608-00 ..... **$805**

Single Compartment with Power supply board –
Order 040-0803-03 ..... **$160**

Single Compartment with Uncommitted Board –
Order 040-0652-06 ..... **$135**

Single Compartment without Board –
Order 040-0821-04 ..... **$70**

Double Compartment with Two Boards –
Order 040-0754-07 ..... **$260**

Rear-Interface Data Book – Order 070-2088-04 ..... **$33**

Flexible Extender Cable – Order 067-0645-02 ..... **$470**

*[1] *Contact your local Tektronix representative for price information.*

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

Oscilloscope Calibration

CONTENTS

OSCILLOSCOPE CALIBRATION

General Information....358
CG 5011 Calibration Generator....362
PG 506A Calibration Generator....362
TG 501A Time Mark Generator....362
SG 5030 Leveled Sinewave Generator....364
SG 502 Oscillator....364
SG 503 Leveled Sinewave Generator....364
SG 504 Leveled Sinewave Generator....364
SCAL101 Core Oscilloscope Calibration System....366
SCAL102 Enhanced Oscilloscope Calibration System....366
SCALCF1 Calibration Fixture....369
SCALPA1 GPIB Pod Adapter....369

Support of Scopes

At Tektronix, we've been building the world's best-engineered and most reliable oscilloscopes for over four decades. Our successes have demanded hard work and uncompromising design, plus an insistence on customer satisfaction.

Inherent in the quality of Tektronix oscilloscopes has been the unequaled support of our products through accurate and precise manual, programmable and automated turnkey calibration systems, service manuals, training programs and standard Tektronix Service offerings.

This is the same calibration equipment we use in our own labs to ensure our scopes are in top condition – and to ascertain whether performance meets or exceeds all specifications. Tektronix automated scope cal systems are specified by the U.S. Military to upgrade their existing calibration equipment as part of their long-term modernization program – a distinction not easily come by.

That's strong support for your own scope cal purchase decision. But there's even more.

Tektronix is a safe buy, certainly, but is also a wise investment. Simply because within our range of scope cal solutions, you are certain to find the level of performance, accuracy and support you need to keep pace with growing requirements. Plus, there is the built-in modularity to allow easy, cost-effective expansion.

A CHOICE OF SOLUTIONS

We'll meet your needs at any level, manual, programmable and fully automated. Our industry-leading TM 500 manual instrumentation provides a wide range of standard amplitude square waves, plus the fastest rise times, the lowest aberrations, the fastest time marks, and the widest leveled sinewave frequency range of any equipment in its class.

The TM 500 set of manual calibration instruments can be configured into a portable test set for in-field oscilloscope service and calibration.

MANUAL SOLUTIONS

The TG 501A Time Mark Generator provides time marks from 5 s to 1 ns, plus a variable timing output which allows you to read the scope's percentage timing error directly on a digital display.

The PG 506A Calibration Generator provides clean, fast-rise square waves and calibrated-amplitude square waves for checking oscilloscope transient response and for setting the vertical-amplifier gain of the oscilloscope respectively. The PG 506A has a variable mode of operation which allows you to read the oscilloscope's calibration error directly in percent from its digital display.

The SG 503 and SG 504 generators provide leveled sine waves for bandwidth checks and triggering performance checks. The range of the SG 503 is 250 kHz to 250 MHz, while the range for the SG 504 is from 245 to 1050 MHz.

The SG 502 Oscillator is perfect for calibration applications where verification of low-frequency rolloff in AC modes and performance measurement of low-frequency-reject triggering modes is required.

PROGRAMMABLE SOLUTIONS

If you manage a cal lab, chances are you're already using Tektronix oscilloscope calibration equipment. In which case our CG 5011 Programmable Calibration Generator and SG 5030 Programmable Leveled Sinewave Generator can help automate test procedures, making them faster and easier for any technician on your staff to perform. Each instrument offers easy test setup over the GPIB, and automated testing has the benefit of virtually eliminating the risk of operator error.

The CG 5011 is designed to cover both analog and digital requirements up to 2 GHz and is ideally suited for environments where multiple scopes are maintained. It is complemented by the SG 5030 Programmable Leveled Sinewave Generator for oscilloscope bandwidth calibration. The SG 5030's leveled output is variable from 0.1 Hz to 550 MHz. Accurately calibrated output voltages are obtained through the use of a remote levelling head which plugs directly into the instrument under test.

Oscilloscope Calibration

CALIBRATION INSTRUMENT SELECTION GUIDE

Instrument	Primary Functions	Secondary Functions	Module Width
CG 5011	Amplitude Calibration Time Base Calibration	Testing risetime and transient response, attenuator compensation, oscilloscope non-linearity	3 Wide
SG 5030	Bandwidth Calibration	Broadband sinewave generation	3 Wide
PG 506A	Amplitude Calibration	Testing risetime and transient response, attenuator compensation	1 Wide
TG 501A	Time Base Calibration	Testing oscilloscope nonlinearity	1 Wide
SG 502	LF Response & Triggering	Low distortion leveled signal source	1 Wide
SG 503	Bandwidth Calibration	General leveled RF signal source	1 Wide
SG 504	Bandwidth Calibration	General leveled RF signal source with frequency modulation capability	1 Wide

AUTOMATED SOLUTIONS

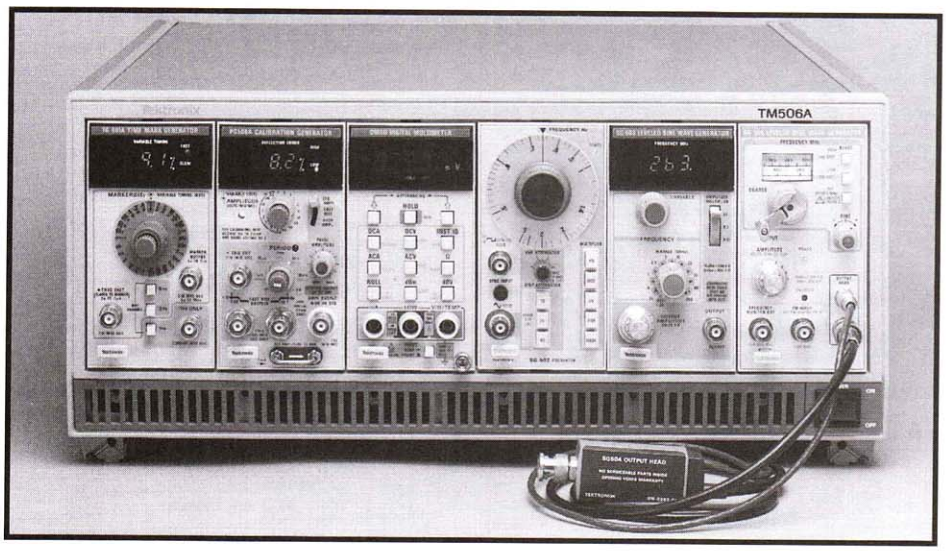
Tektronix also provides turnkey system solutions to support your calibration station requirements. The SG 5030 can be configured with a CG 5011 in a six-slot TM 5006A mainframe and controlled by a high-performance personal computer. Configured with a DM 5110 Digital Multimeter, this forms the first in a series of cost-effective calibration systems for either benchtop or workstation configuration. We call it the SCAL101.

And it is easy to expand to a more powerful system for the automated calibration of scopes and DSOs. Just add an FG 5010 Function Generator, DC 5010 Universal Counter/Timer and an SCALCF1 Calibration Fixture and you have a very powerful SCAL102 system.
With each system we can provide software application packages for a large variety of Tektronix scopes and DSOs. This list is continually growing as we add application packages for new scopes.

You'll find that doing business with Tektronix means more than just purchasing high quality products. You'll also benefit from our traditional commitment to long-term solutions.
To easy, cost-effective expandability. To expert applications assistance. And to continuing updates. All in support of your products and needs. That's our promise to you – our partners.

Finally, whether it's a single instrument or a complete calibration package, you can count on Tektronix to offer more in support of your purchase with clear, comprehensive documentation and worldwide service network second to none. Item for item, we've perfected Tektronix support through years of experience – because we're our own toughest customer.

Oscilloscope Calibration

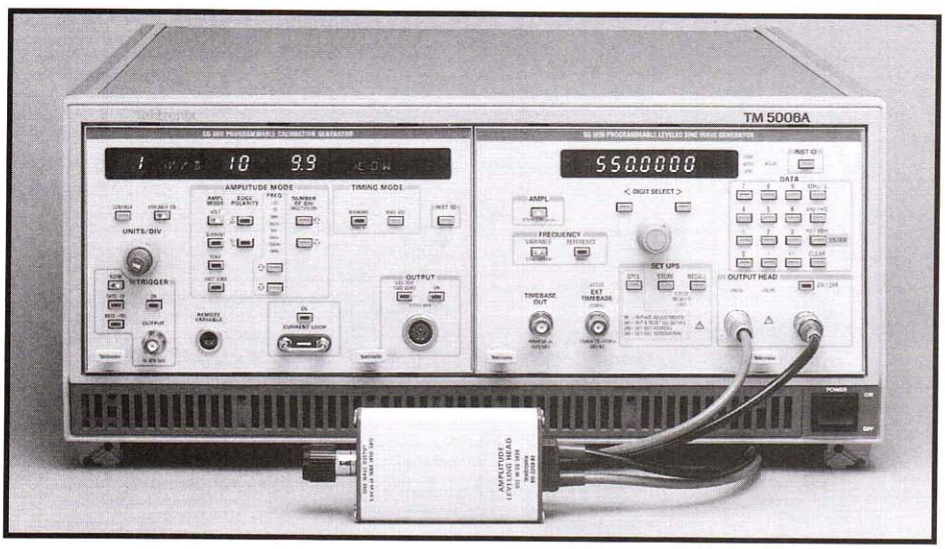


MANUAL SCOPE CAL PACKAGE

- Calibrate oscilloscope time bases with sweep speeds from 5 sec/div to 1 ns/div with the TG 501A.
- Test amplifier transient response to <1 ns with fast rise/fall output using the PG 506A.
- Test amplifier bandwidths from 250 kHz to 1.05 GHz with the SG 503 and SG 504.
- Calibrate trigger circuits with the SG 502 and SG 503.
- Read timing and amplitude deflection errors directly in percent from the PG 506A, TG 501A and SG 503 digital displays.
- Measure oscilloscope power supplies with the DM 511.

Manual Scope Cal Package

Configured for manual calibration and verification of scopes with sweep speeds to 1 ns/div and bandwidths to 1 GHz. Includes a TG 501A Time Mark Generator, PG 506A Calibration Generator, SG 503 and SG 504 Leveled Sinewave Generators, DM 511 Digital Multimeter and SG 502 Oscillator.



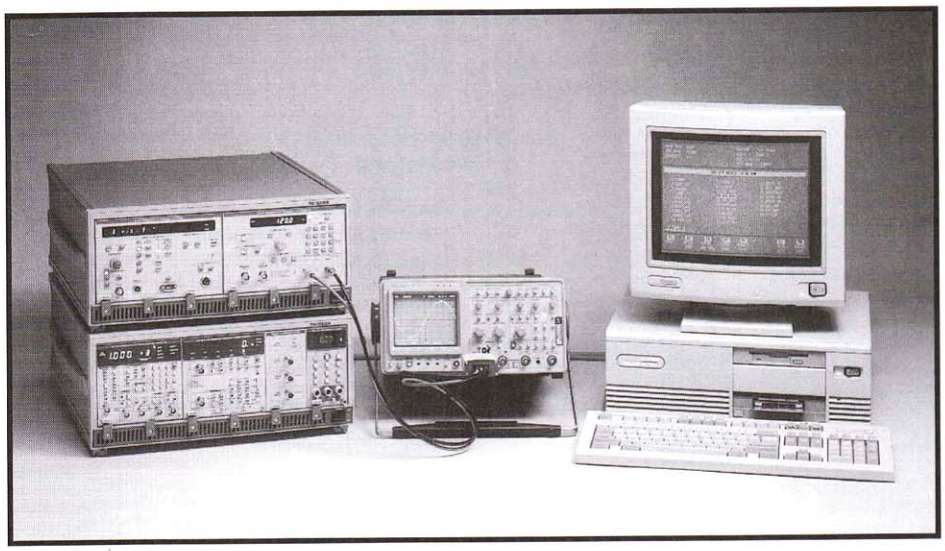
PROGRAMMABLE SCOPE CAL PACKAGE

- The CG 5011 is the preferred choice for calibrating oscilloscopes up to 2 GHz.
- Calibrate oscilloscope time bases with sweep speeds from 5 sec/div to .5 ns/div.
- Test amplifier response with the pulse-head fast rise/fall output of 150 ps.
- Calibrate scope vertical, X-axis and Z-axis amplifier gain using the standard amplitude output.
- Read timing and amplitude deflection errors directly in percent from the digital display.
- Test amplifier bandwidths to 550 MHz using the SG 5030.
- Calibrate trigger circuits down to 0.1 Hz.
- Additional recommended plug-ins include the DM 5110 Digital Multimeter, FG 5010 Function Generator and DC 5010 Universal Counter/Timer.

Programmable Scope Cal Package

Configured for automated calibration and verification of scopes with sweep speeds to 500 ps/div and bandwidths to 500 MHz. Includes a CG 5011 Programmable Calibration Generator and SG 5030 Programmable Leveled Sinewave Generator.

Oscilloscope Calibration



AUTOMATED SCOPE CAL PACKAGE

- Tektronix-approved hardware configurations.
- Tektronix-approved calibration performance verification procedures with recommended adjustment processes.
- Data management/report system.
- Automatic system traceability tracking.
- Five levels of password and security protection.
- Test development tools.
- Variety of input device options (ie, barcode).
- GPIB pod for non-programmable Tektronix 2465/2445 Oscilloscopes.

Automated Scope Cal Package

A series of turnkey automated calibration solutions that can be configured to fit the product mix that you support, at the appropriate level of automation. We can provide computer-aided processes for calibrating manual scopes, as well as automated processes for calibrating programmable scopes which require minimum operator interaction.

CG 5011
PG 506A
TG 501A

Calibration Generators

Solutions for all your oscilloscope calibration needs.

CG 5011

- Vertical Gain
- Horizontal Timing and Gain
- Vertical Bandwidth/Pulse Response Characteristics
- Probe Accuracy and Compensation
- Current-Probe Accuracy
- Calibrator-Output Accuracy
- Next-Cal-Date Tracking

PG 506A

- Three Square-Wave Output Modes
- 10 Hz to 1 MHz
- Direct Readout of Oscilloscope Deflection Error

TG 501A

- Marker Outputs, 1 ns to 5 s
- Direct Readout of Oscilloscope Timing Error
- External Trigger Output

CG 5011

CG 5011

The CG 5011 Programmable Oscilloscope Calibration Generator can be used either manually or as a part of a computerized system for the calibration and verification of major oscilloscope parameters. It is a three-wide TM 5000 compatible plugin which features a wide range of functions, all programmable by controller via the GPIB or from the front panel. A "Learn" mode allows any manually set function or range to be acquired by a controller.

A CG 5011 computer-based test and calibration system can provide step by step instructions to the operator significantly reducing the skill level and/or time required for scope maintenance.

The optional Comparator Head is used to calibrate built-in oscilloscope calibrators. Both the oscilloscope calibrator and the CG 5011 signals are applied to the Comparator Head and simultaneously displayed on the scope's CRT.

The Remote Variable option allows remote operation of the Units/Div, Variable/Fixed button, the Continue push-button, and the VAR.

The CG 5011 is designed to greatly reduce your maintenance costs. Built in self test routines and hardware check the operation of all major circuits each time power is turned on. The Cal-Due-Date is displayed on the front panel.

A calibration certificate to MIL-STD-45662A with data is provided with the CG 5011.

Characteristics

VOLTAGE (AMPLITUDE MODE)
Used to calibrate vertical display accuracy.

Range – 40 µV to 200 V, 1 MΩ load; 40 µV to 5 V, 50 Ω load (1-2-5 steps with multiplier).

Multipliers – 1, 2, 3, 4, 5, 6, 8, or 10.

Polarity – Positive from ground.

Aberrations – Less than ±15% of amplitude (±10 mV).

Accuracy – ±(0.25% + 1 µV).

Frequency – 40 µV to 80 mV: 10 Hz to 10 kHz. 100 mV to 10 V: +DC or –DC, 10 Hz to 100 kHz. 12 V to 200 V: +DC or –DC, 10 Hz to 10 kHz.

Variable Range – ±9.9.%

CURRENT (AMPLITUDE MODE)
Used to calibrate current probes.

Range – 1 mA to 100 mA (1-2-5 sequence).

Multipliers – 1, 2, 3, 4, 5, 6, 8, or 10.

Aberrations – Less 5% of period and less than ±15% of amplitude (±100 µA).

Accuracy – ±(0.25% + 2 µA.).

Frequency – DC or 10 Hz to 1 MHz (decade steps).

Droop – ≤1% p-p.

Variable Range – ±9.9%.

LOW EDGE AND HIGH EDGE (AMPLITUDE MODE)
Used to test oscilloscope input amplifier and attenuator compensation.

Range – 20 mV to 1 Vp-p 50 Ω, Low Edge 1.2 V to 100 Vp-p 1 MΩ load, High Edge (1-2-5 steps with multipliers).

Multipliers – 1, 2, 3, 4, 5, 6, 8, or 10.

Aberrations – ±2% of square wave amplitude.

Accuracy – ±3%.

Polarity – Positive or negative transitions to ground (Low Edge). Positive transitions only (High Edge).

Risetime/Falltime – ≤1.3 ns (Low Edge). ≤100 ns (High Edge).

Long Term Flatness – ±0.5% after first 10 ns (Low Edge). ±0.5% after first 500 ns (High Edge).

Frequency – 10 Hz to 1 MHz in decade steps. (Low Edge). 10 Hz to 100 kHz in decade steps. (High Edge).

Variable Amplitude Range – ≥ ±9.9% from nominal.

MARKERS (TIMING MODE)
Used to calibrate oscilloscope time bases.

Range – 0.5 ns to 5 s (1-2-5 steps).

X10 Magnifier – Increases marker rate by a factor of ten (0.1 µs to 5 s range only).

Accuracy – ±0.0003% (+15°C to + 50°C).

Amplitude – 1 V minimum 5 s to 2 ns, 350 mV minimum: 1 ns, 100 mV minimum: 0.5 ns. into 50 Ω.

Variable Range – ±9.9.%

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

GPIB IEEE-488 — The CG 5011 complies with IEEE Standard 488.1-1987, and with Tektronix Standard Codes and Formats.

Calibration Generators

TRIGGER OUTPUT
The oscilloscope under test is normally triggered externally from this source.

Output Amplitude – 1 V minimum into 50 Ω.

Trigger Rate (Marker Mode) – Normal: Slaved to marker rate from 100 ns to 5 s; remains at 100 ns for faster markers. Divided by 10: Reduces normal trigger rate by a factor of ten. Divided by 100: Reduces normal trigger rate by a factor of one hundred.

All Other Modes – Normal: Slaved to output frequency. Divided by 10: One-tenth output frequency. Divided by 100: One-hundredth output frequency.

REFERENCE FREQUENCY
Output Frequency – 1 MHz with internal time base accuracy.

Output Amplitude – TTL compatible.

Input Frequency – 1, 2, 3, 4 or 5 MHz.

Input Amplitude – 1 V to 10 V RMS.

Required Accuracy – ±0.001%.

Input Resistance – 10 kΩ (Nominal).

FAST EDGE (AMPLITUDE MODE)
The Pulse Head is used to generate fast rise, low-distortion pulses for testing higher bandwidth vertical amplifiers.

Polarity – Positive or negative transitions from ground.

Risetime – ≤150 ps.

Aberrations – ±3% of pulse amplitude; not to exceed 4% p-p for adjacent peaks.

Frequency – 100 Hz to 100 kHz (decade steps).

Amplitude – 1.1 V peak ±5% into 50 Ω.

Variable Range – ±10.% general.

ENVIRONMENTAL
Operating – 0°C to +50°C.

Non-Operating – 20°C to +65°C.

Power Consumption – 65 VA.

PG 506A

The PG 506A Calibration Generator provides three modes of square wave output, selectable DC outputs, and a variable-amplitude output with front panel digital indication of oscilloscope deflection error. Simultaneous, plus and minus low-level, fast-rise (1.0 ns) square waves or high-amplitude (60 V), extremely clean square waves are available at frequencies from 10 Hz through 1 MHz for checking oscilloscope transient response. A 5 mA calibration current loop is useful for current probe calibration. A 1 kHz square wave can be generated in the amplitude-calibration mode. Its amplitude can be varied around the calibrated level until the square wave aligns with the oscilloscope graticule divisions. Scope deflection error can then be read directly off the PG 506A digital display in percentage high or low, permitting rapid verification of oscilloscope performance.

Characteristics

AMPLITUDE-CALIBRATOR MODE
Period – Fixed at ≈1 ms or DC.

Amplitude – From 200 μVp-p to 100 Vp-p in 1-2-5 sequence, accurate within 0.25% into 1 MΩ. 100 μVp-p to 5 Vp-p into 50 Ω.

Error Readout – Range: ±7.5%. Resolution: 0.1%.

PULSE MODES
Period – 1 μs to 10 ms (within 5%) in decade steps with the variable control in Cal position. Variable extends period to at least 100 ms.

Symmetry – ≈50% duty cycle.

HIGH AMPLITUDE OUTPUT
Rise Time – Unterminated: 100 ns or less. Terminated into 50 Ω: 10 ns or less.

Amplitude Range – Unterminated: 6 V or less to at least 60 V. Terminated into 50 Ω: 0.5 V or less to at least 5 V.

Leading-Edge Aberrations – Within 2% or 50 mVp–p, whichever is greater, when terminated into 50 Ω.

TG 501A

The TG 501A Time Mark Generator provides marker outputs from one nano-second to five seconds. A unique feature of the TG 501A is a variable timing output with a front panel two-digit LED display. The display indicates percentage of timing error between the normal time interval and a variable interval that lines up the marker pulse with graticule or division marks on the display. This feature not only provides direct readout in terms of percent error, but also helps eliminate errors associated with visually estimating error from a display.

Characteristics

Markers – 1 ns through 5 s in a 1-2-5 sequence.

Marker Amplitude – ≥1 V peak into 50 Ω on 5 s through 10 ns markers. ≥750 mVp-p into 50 Ω on 5 ns and 2 ns markers. ≥200 mVp-p into 50 Ω on 1 ns markers.

Trigger Output Signal – Slaved to marker output from 5 s through 100 ns. Remains at 100 ns for all faster markers.

Internal Time Base – Crystal Frequency 5 MHz; Stability (0 to 50°C within 5 parts in 10^7 after 1/2 hour; Long-Term Drift 1 part or less in 10^7 per month; Setability adjustable to within 5 parts in 10^8.

External Reference Input – Available with internal changes. Acceptable frequencies, 1 MHz, 5 MHz, or 10 MHz. Input amplitude must be TTL-compatible.

Timing Error Readout Range – To 7.5%.

Timing-Error Measurement Accuracy – Device under test error is indicated to within one least significant digit (to within one displayed count).

ORDERING INFORMATION

CG 5011 Programmable Calibration Generator **$18,995**
Includes: Output Cable Assembly (012-0884-00); Pulse Head (015-0611-00); Instrument Interface Guide (070-7747-00); Instruction Manual (070-7745-00); Programmer's Reference Manual (070-7748-00); Service Manual (070-7746-00).
Opt. 02 – Deletes Pulse Head ..... **–$1,100**

ADDITIONAL ACCESSORIES
Comparator Head – Order 015-0310-01 ..... **$975**
Remote Variable – Order 015-0309-01 ..... **$735**
Pulse Head – (When purchased separately) Order 015-0611-00 ..... **$2,215**
Rigid Circuit Board Extender – Order 067-0975-00 ..... **$170**
Trouble Shooting Aid – Order 067-0974-00 ..... **$585**

PG 506A Calibration Generator **$3,995**
Includes: Instruction Manual (070-6687-00).

ADDITIONAL ACCESSORIES
Precision Voltage Divider – Order 015-0265-00. ..... **$325**
Tunnel-Diode Pulser – Order 067-0681-01 ..... **$395**

TG 501A Time Mark Generator **$3,595**
Includes: Instruction Manual (070-1576-02)

WARRANTY-PLUS SERVICE OPTIONS
Opt. M7 – Calibration Service
CG5011 ..... **+$305**
PG506A ..... **+$90**
TG501A ..... **+$105**

Opt. M9 – Repair Protection
CG5011 ..... **+$585**
PG506A ..... **+$200**
TG501A ..... **+$215**

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

GPIB IEEE-488 — The CG 5011 complies with IEEE Standard 488.1-1987, and with Tektronix Standard Codes and Formats.

SG 5030 | SG 503
SG 502 | SG 504

Leveled Sinewave Generators, Oscillator

Only Leveled Sinewave Generators provide the accuracy for oscilloscope bandwidth testing.

SG 5030

- Oscilloscope Bandwidth Calibration
- 0.1 Hz to 550 MHz
- 4.5 mV to 5.5 V Amplitude Range
- Amplitude Flatness From ±1.5% to ±4% of 50 kHz Reference Frequency
- 20 Stored Front Panel Settings

SG 502

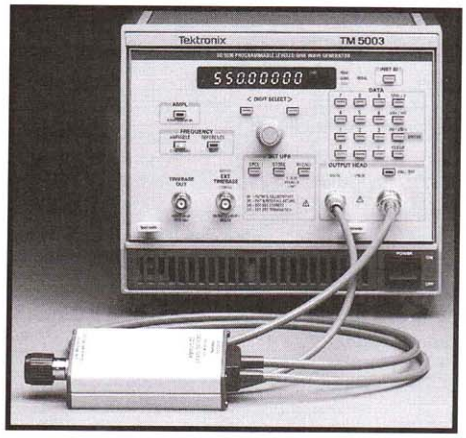
- 5 Hz to 500 kHz Sine Waves and Square Waves
- Low-Distortion Sine Wave
- 5 V RMS Open Circuit – 600 Ω Source
- 0 to 40 dB Output Variable Plus 0 to 70 dB in 10 dB Steps

SG 503

- 250 kHz to 250 MHz
- Leveled, Variable Output
- Digital Readout of Frequency

SG 504

- 245 to 1050 MHz
- Leveled, Variable Output
- Frequency-Modulation Capability
- Internal Peak Detection



SG 5030 Leveled SineWave Generator

The SG 5030 is the only choice for anyone who needs leveled output amplitude to calibrate analog or digital scopes with bandwidth to 550 MHz – under either local or programmable control. That's because no other programmable leveled sine wave generator is built specifically to fill scope calibration requirements. The SG 5030's leveled output is variable from 0.1 Hz to 550 MHz with a reference frequency of 50 kHz. Crystal-controlled frequency accuracy eliminates drift so there's no second-guessing results.

Accurately calibrated output voltage is provided from 4.5 mV to 5.5 V peak-to-peak into 50 Ω. Absolute amplitude accuracy is ±1.5% from 0.1 Hz to 50 kHz, with flatness from ±1.5 to ±4% over the remainder of the frequency range to 550 MHz.

A remote leveling head is standard and plugs directly into the oscilloscope to ensure that the output signal is level at all times. All other signal generators are specified at the front-panel BNC connector, not at the end of the cable going to the instrument under test.

Frequency and amplitude along with 20 front-panel store/recall settings are all fully programmable. Automating test procedures makes scope calibration some four times faster than manual test methods allow – and virtually eliminates the risk of operator error.

Configure the SG 5030 with a CG 5011 Programmable Calibration Generator. As three-wide TM 5000 Series modules, they conveniently fill a six-slot TM 5006A mainframe to form a complete, cost-effective benchtop or rackmount calibration system.

Characteristics

FREQUENCY

Range/Resolution –
0.1 Hz – 4.9999 kHz: 0.1 Hz steps;
5 kHz – 49.999 kHz: 1 Hz steps;
50 kHz – 550 MHz: 10 Hz steps.

Accuracy With Internal Timebase (within 1 year of adjustment) –

Range	ppm of Setting + Hz
0.1 Hz – 4.9999 kHz:	± (3 + 0.06)
5 kHz – 49.999 kHz:	± (3 + 0.3)
50 kHz – 550 MHz:	± (3 + 3)

Accuracy With External Timebase (10 MHz) –
0.1 Hz – 4.9999 kHz: ± (ext. t.b. error + 0.06 Hz);
5 kHz – 49.999 kHz: ± (ext. t.b. error + 0.3 Hz);
50 kHz – 550 MHz: ± (ext. t.b. error + 3 Hz).

AMPLITUDE

Range/Resolution –
4.5 mV – 55 mV: 0.02 mV/step;
55.2 mV – 550 mV: 0.2 mV/step;
552 mV – 5.5 V: 2 mV/step;
–42.95 dBm – +18.75 dBm: 0.05 dBm/step.

Accuracy (within 1 year of adjustment) –
0.1 Hz – 50 kHz: ±1.5% of setting.

Flatness (within 1 year of adjustment) –
50 kHz – 100 MHz: ±1.5% of 50 kHz Ref. Frequency;
100 MHz – 250 MHz: ±3% of 50 kHz Ref. Frequency;
250 MHz – 550 MHz: ±4% of 50 kHz Ref. Frequency.

OUTPUT

Leveling Settling Time – Less than 20 ms.

Source Resistance – 50 Ω, ±1%.

DC Offset – ±20 mV.

VSWR – Less than 1.2:1 up to 550 MHz.

HARMONIC DISTORTION

0.1 Hz – 49.999 kHz – All Harmonics and Spurs <–50 dBc.

50 kHz – 550 MHz – 2nd Harmonic <–30 dBc. All others <–35 dBc. Nonharmonics <–40 dBc. Phase Noise <–85 dBc/Hz at 10 kHz offset.

INTERNAL TIMEBASE OUTPUT

Frequency – 10 MHz.

Accuracy – ±3 ppm.

Amplitude – 400 mV p-p into 50 Ω.

Impedance – 50 Ω.

EXTERNAL TIMEBASE INPUT

Frequency –10 MHz, ±1.5 ppm.

Amplitude – –10 dBm to +10 dBm, (70 to 700 mV rms).

Impedance – 50 Ω AC, 500 Ω DC.

GENERAL

Environmental – Operating 0°C to 40°C. Non-operating: 40°C to +71°C.

Power Consumption – 65 VA.

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

GPIB IEEE-488 The SG 5030 complies with IEEE Standard 488.1-1987, and with Tektronix Standard Codes and Formats.

Leveled Sinewave Generators, Oscillator

SG 5030 | **SG 503**
SG 502 | **SG 504**

SG 502

SG 503

SG 504

SG 502 Oscillator

The SG 502 features a wide frequency range of 5 Hz to 500 kHz with low distortion (0.035% between 20 Hz and 50 kHz) and is desirable for general test purposes. Other features include 70 dB amplitude control plus a simultaneous fixed-amplitude square wave.

Characteristics

Frequency Range – 5 Hz to 500 kHz in 5-decade steps. Frequency accuracy within 5% of dial setting from 5 Hz to 50 kHz; within 10% of dial setting from 50 to 500 kHz.

Amplitude Response (1 kHz Reference) – Flatness: 0.3 dB over entire range.

Attenuation – Selectable from 0 to 70 dB in 10-dB steps with pushbuttons. Accurate within 0.2 dB for each step selected, additive. An uncalibrated control provides continuous variation from 0 to 40 dB.

Harmonic Distortion – <0.035% (70 dB) from 20 Hz to 50 kHz. <0.15% from 50 to 500 kHz RL ≥600 Ω.

Maximum Output Voltage – 5 V RMS open circuit; 2.5 V RMS into 600 Ω.

Output Impedance – 600 Ω, grounded.

SQUARE WAVE

Freq. Range/Accuracy – Same as sine wave.

Rise Time and Fall Time – 50 ns or less.

Amplitude – +5 V, fixed, open circuit.

Output Impedance – 600 Ω, grounded.

SG 503 Leveled Sinewave Generator

The SG 503 provides a leveled output that is variable in frequency from 250 kHz to 250 MHz. The selected frequency is indicated by a built-in autoranging frequency counter with a three-digit LED readout on the front panel. Accurately calibrated output voltage is variable from 5 mV to 5.5 V peak-to-peak into 50 Ω.

Characteristics

Frequency Range – 250 kHz to 250 MHz, plus 50 kHz reference frequency.

Frequency Accuracy – Within ±0.7 of one count of the least significant digit of indicated frequency.

Amplitude Range – 5 mV to 5.5 Vp-p into 50 Ω termination in three decade ranges.

Amplitude Accuracy (50 kHz Reference) – Within 3% of indicated amplitude on (X1) range, 4% on (X.1) range, and 5% on (X.01) range.

Flatness (P-P) – From 250 kHz to 100 MHz, output amplitude will not vary more than 1% of the value at 50 kHz except that up to +1.5%, –1% variation may occur between 50 and 100 MHz on amplitude multiplier X.1 and X.01 ranges only. From 100 to 250 MHz, amplitude variation is within 3% of the value at 50 kHz.

Harmonic Content – Second Harmonic: At least 35 dB down. Third Harmonic and All Higher Harmonics: At least 40 dB down.

Rear Interface – Addresses the leveling circuit.

SG 504 Leveled Sinewave Generator

The SG 504 provides leveled output amplitude and is variable from 245 to 1050 MHz in two bands via its compact output leveling head. Frequency is indicated by a high-resolution tape dial that expands each band over 28 inches. The accurately calibrated output voltage is variable from 0.5 V to at least 4.0 Vp-p into 50 Ω.

Characteristics

Frequency Range – Low Band: 245 to 550 MHz. High Band: 495 to 1050 MHz, plus 50 kHz or 6 MHz reference frequency (internally selected).

Frequency Accuracy – ±2% of dial indication.

Amplitude Range – 0.5 V to at least 4.0 Vp-p.

Amplitude Accuracy (At Reference) – Within 3% of indicated amplitude.

Flatness – ±4% of amplitude at reference frequency.

Harmonic Content – Second Harmonic: At least 25 dB down. Third Harmonic and All Higher Harmonics: At least 40 dB down.

FM Input – Frequency Range: DC to 100 kHz. Deviation Sensitivity: ±9 V produces from 0.05% to 0.5% deviation of carrier, depending on output frequency.

Frequency Monitor Output – ≥ 0.3 Vp-p into a 50 Ω load from 245 to 1050 MHz.

Rear Interface – Address FM input, frequency-monitor output, and amplitude control.

ORDERING INFORMATION

SG 5030 Programmable Leveled Sine Wave Generator **$9,650**
Includes: Operators Manual (070-7705-00), Instrument Interfacing Guide (070-7704-00), Reference Guide (070-7706-00), Leveling Head (015-2350-00).

SG 502 Oscillator **$1,800**
Includes: Instruction manual (070-1430-01).

SG 503 Leveled Sinewave Generator **$3,895**
Includes: Three-foot precision 50 Ω cable (012-0482-00) Instruction Manual (070-6770-00).

SG 504 Leveled Sinewave Generator **$5,350**
Includes: Instruction Manual (070-1632-01); Leveling head (012-0282-01).

WARRANTY-PLUS SERVICE OPTIONS

Opt. M7 – Calibration Service
SG5030 ..... **+$105**
SG502 ..... **+$70**
SG503 ..... **+$100**
SG504 ..... **+$170**

Opt. M9 – Repair Protection
SG5030 ..... **+$145**
SG502 ..... **+$160**
SG503 ..... **+$235**
SG504 ..... **+$270**

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

Oscilloscope Calibration Systems

Oscilloscope calibration solutions that have become the "Industry Standards."

SCAL 101/SCAL 102

- Complete Turn-Key Systems
- Over 30 Scope Procedures
- Industry Proven Calibration Instruments
- Reduced Calibration Times
- Easy to Use
- Test Development Tool Kit

SCAL 102 in Cal Lab.

ScopeCal Systems

The SCAL Systems provide a turnkey solution that completes the "OSCILLOSCOPE SUPPORT PORTFOLIO." This will bring you closer as a Partner to our manufacturing and service groups than ever before. All our solutions are designed to provide you with a cost effective series of choices. These choices are driven by your mix of oscilloscope products and the technology that is represented.

TOTAL SOLUTION WITHOUT COMPROMISE

These turnkey solutions provide the same set of standards that we use in our own facilities with the assurance that the systems, the calibration processes, and our test methods comply with a variety of standards, such as:

- MIL-STD-45662A
- ISO STD 9000
- NQA-1

These solutions will also:

– Ensure traceability to NIST.

– Improve quality of calibration by providing increased accuracies and repeatable results.

– Dramatically reduce calibration times.

These calibration solutions are configured to fit the product mix that you support, and at a level of automation that is appropriate. This includes computer-aided processes (for manual scopes), through fully automated processes that require virtually no operator interaction.

HARDWARE

Tektronix SCAL 101 and 102 come with the best hardware available. We've utilized every bit of DSO, and scope calibration know-how to design a system that can anticipate your needs, and exceed them.

We begin with the Calibration Generator that's become an industry-standard, the Tektronix CG 5011. Then we follow-up with the SG 5030, Leveled Sine Wave Generator. With its remote leveling head, this sine source provides a precision constant amplitude between 0.1 Hz and 550 MHz – giving your amplifier bandwidth, and trigger sensitivity the highest measurement accuracy. This could be the difference between failing a piece of equipment that should have passed – or worse still – passing one that should have failed.

DSOs and modern scopes are getting more and more complex – so we have added products in our SCAL 102 system to meet these extended requirements. A DC 5010, 350 MHz Universal Counter Timer makes testing of triggers, internal clocks, and calibrator functions easier, and the FG 5010, 20 MHz Function Generator adds increased ability to test unique scope functions. And, our SCALCF1 Calibrations Fixture provides stimulus for special test requirements.

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

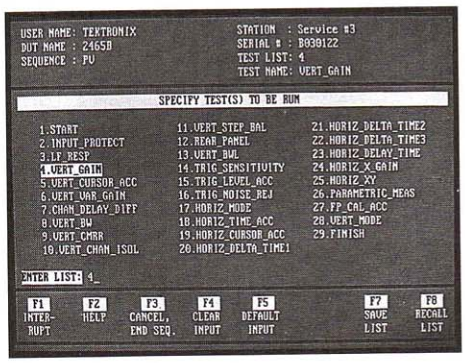
GPIB IEEE-488 — The SCAL 101/102 comply with IEEE Standard 488.1, and with Tektronix Standard Codes and Formats.

Oscilloscope Calibration Systems

SOFTWARE

So you won't be required to develop your own – Tektronix provides an extensive software library of over 30 calibrations and adjustment procedures. These procedures have readily available, on-line HELP files that describe the test methods, test trouble-shooting hints, and user interface information.

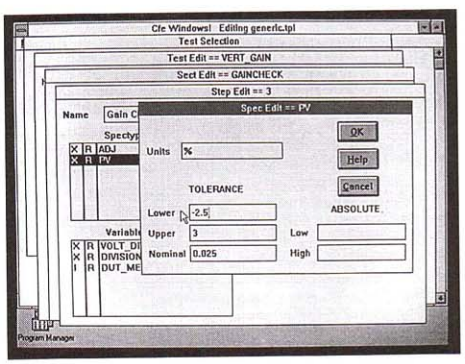
These procedures are used in our Worldwide Service Organization, and for the current products, they are also used in our manufacturing facilities. Plus, Tektronix will support these procedures for the life of the product the procedures were intended to support. Each procedure was created from a selection of over 30 test methods. These test methods (such as: bandwidth, vertical gain, and trigger sensitivity) are the processes that scope people have used for years.



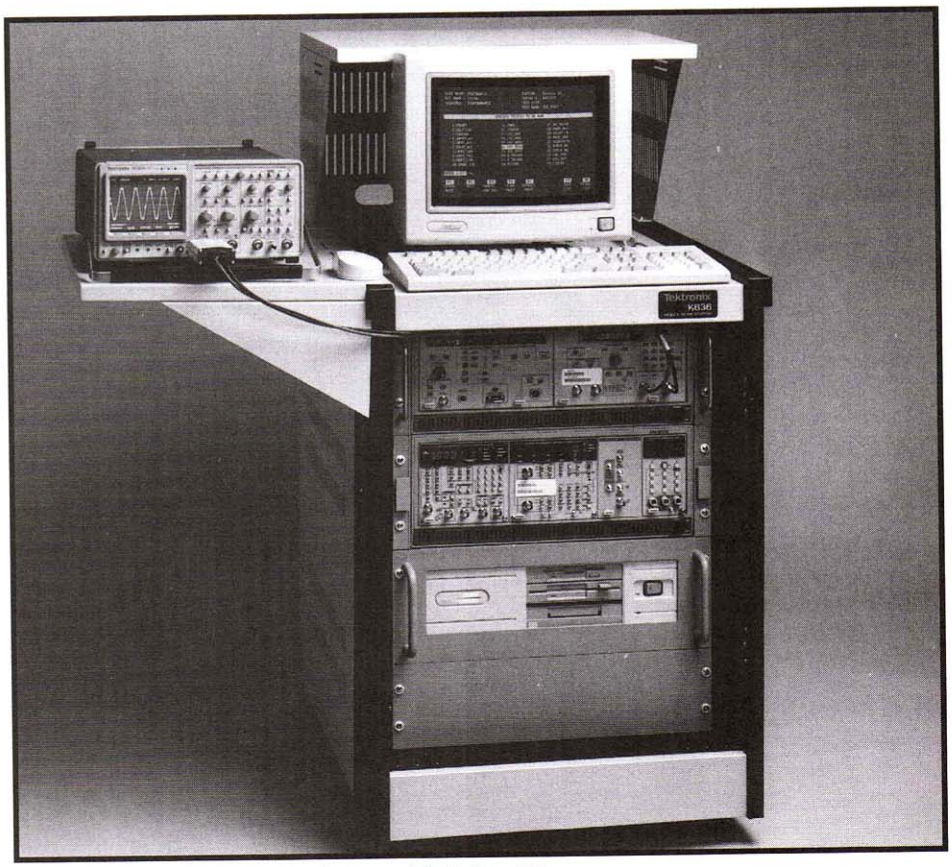
Test Methods for 2430A

Develop Your Own Procedures

Tektronix doesn't ask anyone to learn a special language in order to develop new procedures with our system, but provides easy access through a Microsoft™ Windows-driven tool – even for non-computer-science-skilled people. This also gives you the flexibility to modify our procedures to fit your calibration policy. We package these easy-to-access test methods in a test development "tool kit" – making it easy for you to reduce your development and evaluation times.



Windows driven menu eases test development.



Tektronix ScopeCal SCAL 102 System with Option 06.

FEATURES/OPTIONS

Our Systems deliver ready flexibility to scope calibration – offering choices that make sense – like a bar code reader for speedy input – or a GPIB Pod Adapter which reduces calibration time on non-programmable 2445A/B and 2465A/B oscilloscopes. And, we know how difficult it can be to pull useful information from a report that's cluttered with unnecessary extras – our report generation feature allows you to collect the information you need – and output it in the format that suits you best.

SUPPORT

Every ScopeCal package includes a variety of software, on-site installation and training, plus 90 day on-site System Support.

Tektronix won't leave until the equipment is fully installed, configured to your specifications, is completely operational, all questions have been answered, and reduced calibration time is achieved. This is a promise. We want to make sure that there is no loose ends. Tektronix is committed to providing total, turnkey solutions – and we won't settle for anything less.

CALIBRATION PROCEDURE PACKAGES

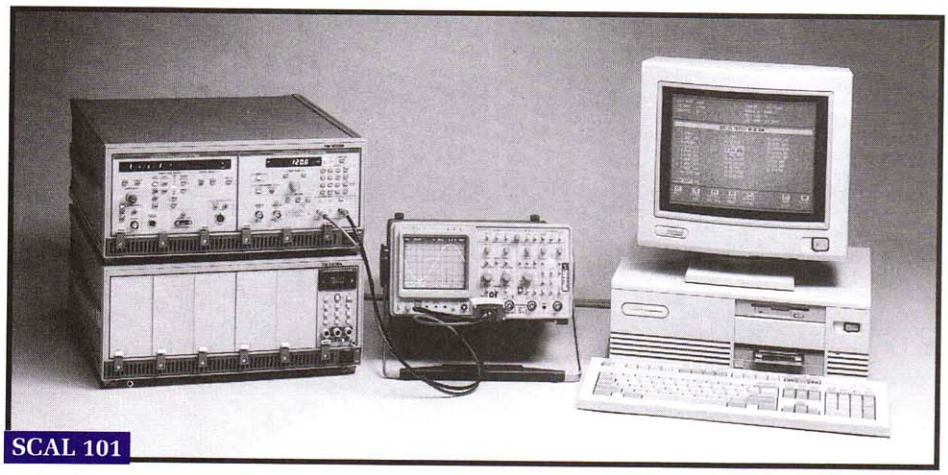
Software package options offer calibration tools designed to support specific products. If there are accessories above those in Option 02, the application family will include them, as noted. ScopeCal software is not a stand-alone package and does require the ScopeCal system in order to function.

Package #	Oscilloscopes Supported
S75SC01	422, 434, 453, 454, 465, 465B, 475, 475A, 485
S75SC03	7603, 7613, 7623A, 7704A, 7904 7A16A, 7A18, 7A24, 7A26, 7B53A, 7B80, 7B85 Includes required calibration accessories.
S75SC04	2445A, 2445B, 2465A, 2465B Includes required calibration accessories.
S75SC05	2430, 2430A, 2432, 2432A, 2440 Includes required calibration accessories.

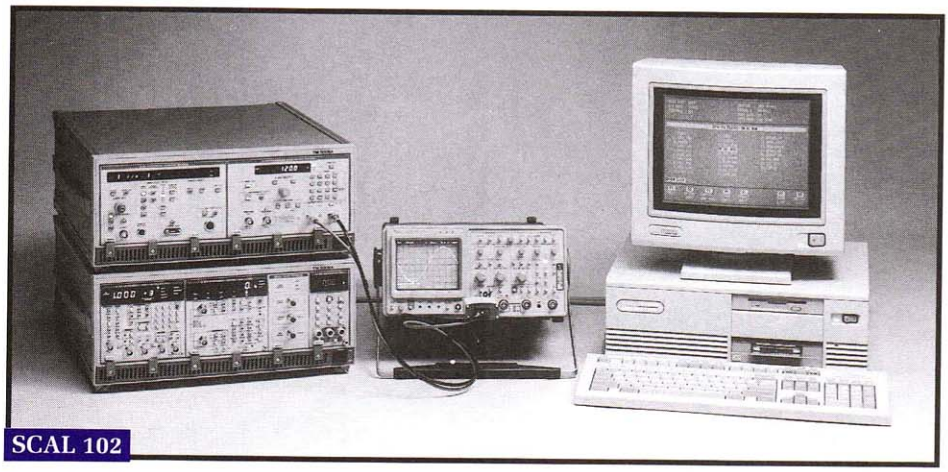
Continued on next page.

SCAL 101
SCAL 102

Oscilloscope Calibration Systems



SCAL 101



SCAL 102

Standard System Offerings

These Turnkey systems are controlled by an IBM PC-compatible 386 controller. These controllers are equipped with 120 MB Hard Disk, 4 MB RAM, 2 GPIB interfaces, streamer tape unit, RS-232-C ports, Centronics Printer Port, VGA monitor, and room for future system enhancements. After installation of one of these systems, you just turn it on and start using it through an easy to use menu system.

SCAL 101 CORE SYSTEM

SCAL 101 is the Core system. This system supports most manual and analog scopes. The SCAL 101 consist of the following instrumentation:

- 386 PC-Compatible Controller
- CG5011 Calibration Generator
- SG5030 w/Leveling Head
- DM5110 Digital Voltmeter
- 2 TM5006A Power Supply Mainframes
- Software which includes: Turnkey System Menu, Report Gen, Test Development Tool Kit, System Diagnostic Tools, and more.

This configuration supports the products listed in software packages: S75SC01, S75SC03.

SCAL 102 ENHANCED SYSTEM

SCAL 102 is the Enhanced Oscilloscope Calibration System consisting of:

- 386 PC-compatible Controller
- CG5011 Calibration Generator
- SG5030 w/Leveling Head
- DM5110 Digital Voltmeter
- DC5010 Timer/Counter
- FG5010 Function Generator
- 2 TM5006A Power Supply Mainframes
- SCALCFI Calibration Fixture
- Software includes: Turnkey Menu System, Report Gen, Test Development Tool Kit, System Diagnostic Tools, and more.

This configuration supports the following products with ready to go turnkey software: S75SC01, S75SC03 S75SC04, and S75SC05

SYSTEM UPGRADES ARE ALSO AVAILABLE!

If you already have part of the hardware needed for these system configurations, system upgrades are available. Your local Tektronix Representative will assist you with determining your product support requirements.

FLEXIBILITY IS THE NAME OF THE GAME!

Through our Calibration Solutions and Service Offerings, we can adjust to your calibration requirements quickly and conveniently. By combining your requirements with our solutions and capabilities, we will ensure a long partnership in support of your products and needs.

BAR CODE READER (OPTION 01)

Adding a Bar Code reader to the system will assist in providing further efficiency in the lab. It uses solid-state visible laser technology, and interfaces with the controller through a keyboard wedge interface.

ACCESSORIES PACKAGE (OPTION 02)

This optional accessories package provides all the cables, attenuators, terminators, dividers, normalizers, and probes to test the majority of products supported by the ScopeCal systems. If there are additional accessories required for individual supported product families, they will be included or specially noted (ie. 7000 series).

DATA PRECISION 8200 VOLTAGE CALIBRATOR (OPTION 03)

This option provides a low cost solution for calibrating the DC accuracy of the TDS500 and TDS600 DSOs in order to meet the requirements of ISO9000/MIL-STD-45662A. This is to ensure that the system can maintain a better then 4:1 ratio between the instrument being calibrated and the calibration instrument being used.

RACKMOUNTS FOR THE TM5006As (OPTION 05)

If you are planning to rackmount the calibration system yourself, this option will add the TM5006A Option 10 consisting of rack ears, slides, and a more powerful cooling fan to the two TM5006A mainframes.

SYSTEM MOUNTED IN MOBILE WORKSTATION (OPTION 06)

For those labs that need mobility within their group, this option will provide the system mounted in a Tektronix K636 Mobile Workstation.

DELETE PC CONTROLLER INTEGRATE YOUR CONTROLLER (OPTION 09)

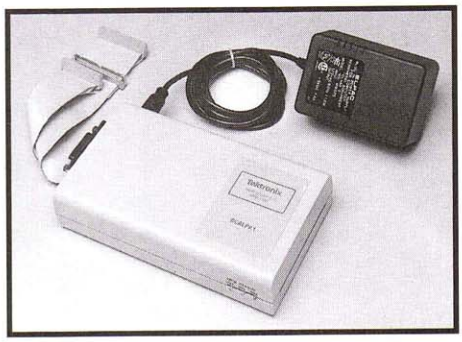
The controller you wish to use must meet our minimum configuration requirements of typical standard PC386 machines. A local Tektronix representative will assist you in determining if those requirements are met.

INTEGRATE CUSTOMER OWNED HARDWARE, DELETE NEW HARDWARE (OPTION 10 TO 14)

These options are available to ensure that those customers who already have an investment in Tektronix calibration solutions will be able to evolve without having to reinvest. A local Tektronix representative can assist you to ensure that your existing hardware will be compatible and will integrate into these system configurations.

Oscilloscope Calibration Systems

SCALCF1 Calibration Fixture



SCALPA1 Pod Adapter

SCALCF1 CALIBRATION FIXTURE
The SCALCF1 is a 1-wide TM 5000 module designed to provide unique capabilities for the SCAL 102 ScopeCal system. The three unique functions it provides are, a programmable 20 VDC supply for over voltage testing of input circuits, a capacitance meter for measuring input capacitance and a line trigger circuit to provide in-phase line trigger signals. All three functions are fully programmable over the GPIB.

SCALPA1 GPIB POD ADAPTER
The S75SC04 2400ART Series Application Software requires the scope being calibrated to have a GPIB interface. The SCALPA1 allows a non-GPIB version of a 2445A/B or 2465A/B to be temporarily adapted to GPIB operation for the duration of the calibration. It involves removing the scope covers and connecting the ribbon cable from the pod adapter to an internal connector in the scope. The time savings by doing this are substantial.

The pod adapter is powered by 5V obtained from a wall mounted power converter. Because the standard power converter operates from 110V only, we have set up an A1 and A2 option for the SCALPA1. Customers who would normally order the A3 Australia or A5 Switzerland options should select the nearest alternative option (A1 or A2).

ORDERING INFORMATION

SCAL 101
Core Oscilloscope Calibration System **$49,995**
Opt. 01 – Bar Code Reader ..... **+$1,950**
Opt. 02 – Accessories Package ..... **+$1,577**
Opt. 05 – Rackmounts for TM 5006As ..... **+$220**
Opt. 06 – Equipment rackmounted in K636 Rack ..... **+$2,700**
Opt. 08 – Delete Monitor ..... **–$500**
Opt. 09 – Delete PC 386. Integrate customer's PC ..... **–$3,000**
Opt. 10 – Delete CG 5011 ..... **–$18,995**
Opt. 11 – Delete SG 5030 ..... **–$9,875**
Opt. 12 – Delete DM 5110 ..... **–$1,125**
Opt. 13 – Delete 1 TM 5006A ..... **–$1,195**
Opt. 14 – Delete 2 TM 5006As ..... **–$2,390**
Opt. 21 – S75SC01 Application Software ..... **+$1,596**
Opt. 23 – S75SC03 Application Software ..... **+$1,694**

SCAL 102
Enhanced Oscilloscope Calibration System **$62,995**
Opt. 01 – Bar Code Reader ..... **+$1,950**
Opt. 02 – Accessories Package ..... **+$1,577**
Opt. 03 – Data Precision 8200 Voltage Calibrator ..... **+$4,500**
Opt. 05 – Rackmounts for TM 5006As ..... **+$220**
Opt. 06 – Equipment rackmounted in K636 Rack ..... **+$2,700**
Opt. 08 – Delete Monitor ..... **–$500**
Opt. 09 – Delete PC 386. Integrate Customer's PC ..... **–$3,000**
Opt. 10 – Delete CG 5011 ..... **–$18,995**
Opt. 11 – Delete SG 5030 ..... **–$9,875**
Opt. 12 – Delete DM 5110 ..... **–$1,125**
Opt. 13 – Delete 1 TM 5006A ..... **–$1,195**
Opt. 14 – Delete 2 TM 5006As ..... **–$2,390**
Opt. 15 – Delete FG 5010 ..... **–$4,855**
Opt. 16 – Delete DC 5010 ..... **–$4,335**
Opt. 21 – S75SC01 Application Software ..... **+$1,596**
Opt. 23 – S75SC03 Application Software ..... **+$1,694**
Opt. 24 – S75SC04 Application Software ..... **+$2,831**
Opt. 25 – S75SC05 Application Software ..... **+$2,821**
SCALCF1 – SCAL 102 Calibration Fixture ..... **+$3,500**
SCALPA1 – GPIB Pod Adapter for 2445 A/B &2465 A/B ..... **+$3,295**

INTERNATIONAL POWER PLUG OPTIONS
Opt. A1 – Universal Euro 220 V, 50 Hz ..... **NC**
Opt. A2 – United Kingdom 240 V, 50 Hz ..... **NC**

SOFTWARE
See Software Section for additional information.
S75SC01 – 400 Series Application Software ..... **+$1,995**
S75SC03 – 7K Series Application Software ..... **+$2,093**
S75SC04 – 2400 ART Series Application Software ..... **+$3,565**
S75SC05 – 2400 DSO Series Application Software ..... **+$3,545**

INTERNATIONAL POWER PLUG OPTIONS
Opt. A1 – Universal Euro 220 V, 50 Hz ..... **NC**
Opt. A2 – United Kingdom 240 V, 50 Hz ..... **NC**
Opt. A3 – Australian 240 V, 50 Hz ..... **NC**
Opt. A4 – North American 240 V, 60 Hz ..... **NC**
Opt. A5 – Switzerland 220 V, 50 Hz ..... **NC**
See General Customer Information Section for additional description.

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

GPIB IEEE-488 — The SCAL 101 and SCAL 102 comply with IEEE Standard 488.1, and with Tektronix Standard Codes and Formats.

Basic Bench Test Instruments

CONTENTS

BASIC BENCH TEST INSTRUMENTS

Basic Bench Set 371
Digital Multimeters 372, 384
Function Generators 377
Counters 380
Power Supplies 388

Tektronix has a complete line of low cost, bench test instruments for both basic and advanced test benches: Triple output power supplies, Digital and Programmable multimeters, Function generators, Multifunction counters.

Instrument and operator safety are all important. Tektronix TM250 and TM2500 Series instruments comply with independent safety certification standards established by UL, CSA, or ETL.

The TM Series instruments are covered by a one year warranty.

Power Supplies

The CPS250 power supply is a versatile instrument with one fixed and two variable outputs. Two switchable analog meters, and switchable outputs operating independently, in series, or in parallel, make this power supply ideal for lab and field work.

Digital Multimeters

Tektronix digital multimeters measure AC and DC voltage and current, plus resistance and decibels.

The New DM2510 and DM2510G Digital Programmable Multimeters provide exceptional accuracy and speed, especially in repetitive testing situations. The DM2510G has a GPIB interface for computerized remote operation and data capture.

Function Generators

Tektronix TM250 Series function generators produce TTL signals and square, sine, and triangle waves for testing amplifiers, filters, and digital circuits. The frequency range of these Tektronix instruments runs from 0.1 Hz to 11 MHz. Sweep functions can be controlled internally or by an external signal.

The CFG280 includes a 1 Hz to 100 MHz integral counter.

Multifunction Counters

Tektronix benchtop counters accurately measure the frequency of sine, square, and triangle waves. The counters span the frequency range from 1 Hz to 1.3 GHz, and several counters also provide period, totalize, frequency ratio, and time interval measurements.

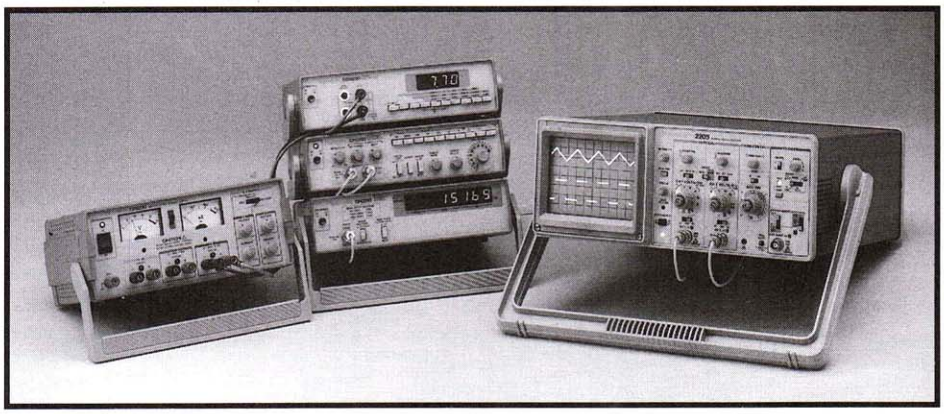
The CDC250 and CMC251 have a temperature-compensated time base to ensure accurate performance in changing ambient conditions. Service technicians will find these two meters useful as standards for calibrating other equipment.

TM250 Basic Bench Set

Whether you are setting up a lab, a production line, or replacing a mismatched collection of old instruments, you will find this set a cost effective way to get the measurement power you need to do the job right. The TM250 Basic Bench Set is unbeatable in a classroom when used with the excellent instructional materials available from Tektronix.

The set includes the CFG250, CDM250, and CPS250. You will want to add your choice of optional counters or a basic oscilloscope for more complete test and measurement capability.

Basic Bench Set



Basic equipment for the electronics technology lab station includes an oscilloscope (2205), function generator (CFG250), digital multimeter (CDM250), frequency counter (CFC250), and a triple output power supply (CPS250).

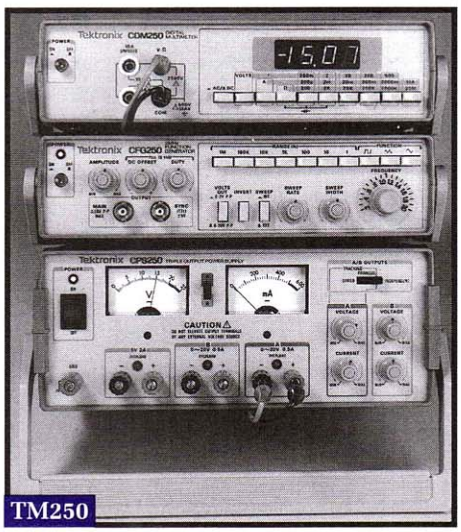
TM250 Basic Bench Set

An economical way to get the instruments you need to configure a bench or classroom lab station is to order the TM250 Basic Bench Set. Excellent workbooks, videos, and other classroom materials available from Tektronix make this set the first choice among educators.

With the addition of your choice of these optional counters and a basic oscilloscope, a set can be configured to fulfill your particular test or training needs.

- CFC250 – 100 MHz Frequency Counter.
- CMC250 – 1.3 GHz Multifunction Counter.
- CDC250 – 175 MHz Universal Counter.
- CMC251 – 1.3 GHz Multifunction Counter with High Stability Time Base.
- 2205 20 MHz Oscilloscope.

See page 394 for instruction material on the TM250 Series.



TM250

TM250

- Digital Multimeter
- 2 MHz Function Generator
- Triple Output Power Supply

APPLICATIONS

- Electronics Service Bench
- Classroom Labs: Electronics Technology, Physics, Electrical, Engineering
- Manufacturing Production Test

Economical configuration for bench or classroom.

TD

Call Direct – Product available within 24 hours, (through TekDirect only). Call 1-800-426-2200. Also available through an Authorized Tektronix Distributor (listed on page 540).

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

ORDERING INFORMATION

TM250

Basic Bench Set ..... TD **$1,040**

Includes: CFG250 2 MHz Function Generator; CPS250 Triple Output Power Supply; CDM250 Digital Multimeter.

Opt. 01 – CFC250 100 MHz Frequency Counter ..... **+$345**

Opt. 02 – CMC250 1.3 GHz Multifunction Counter ..... **+$495**

Opt. 03 – CDC250 175 MHz Universal Counter ..... **+$525**

Opt. 04 – CMC251 1.3 GHz Multifunction Counter with High Stability Time Base ..... **+$545**

RECOMMENDED ACCESSORIES

Test Leads –

Shrouded banana plugs and hook tips, UL approved. Order ALM01 ..... **$25**

Nonshrouded banana plugs and hook tips, Non-UL. Order ALM02 ..... **$25**

Nonshrouded banana plugs with hook tip and alligator clip, non-UL. Order ALM03 ..... **$40**

DM250
DM251
DM252
DM253
DM254

Handheld Multimeters

Rugged Handheld Multimeters for Field/Plant Maintenance, Electronic Troubleshooting, Classroom Labs.

DM250

- 3 1/2 Digit LCD with Analog Bar Graph
- Auto Power Off After 30 Minutes from Last Function or Mode Change
- Autoranging, Data Hold, Memory Offset
- Rugged, Water-Resistant, Yellow Case with Built-in Stand and Probe Holders
- UL Listed
- One Year Warranty

DM253

- 3 1/2 Digit LCD
- Over-range Indication
- Low Battery Indication
- Rugged Yellow Case with Built-in Stand
- Designed to UL 1244 Specifications
- One Year Warranty

DM251/DM252/DM254

- 3-3/4 digit, 4000 Count
- True rms meter (DM254)
- 0.1% Basic DCV Accuracy (DM252, DM254)
- 0.3% Basic DCV Accuracy (DM251)
- Autoranging, Data Hold, Relative Mode
- Memory Store and Recall
- Auto Power Off
- Min/max Hold Function
- Water Resistant and Dust Proof Case
- Three Year Warranty

DM250

DM250

The DM250 is a compact, handheld, battery operated test instrument. For applications in field servicing, on the laboratory workbench, for the electronic hobbyist, and for home electrical service or appliance testing and repair. It has the following measurement capabilities: DC and AC voltages, DC and AC current, Resistance, Diode testing and continuity checking.

DM253

DM253

The DM253 offers 3 1/2-digit testing of capacitance, resistance, transistors, diodes, LEDs and batteries. Twenty-six user ranges ensure versatility.

DM251/DM252/NewDM254

DM251/DM252/NewDM254 Handheld Multimeters

The compact DM251/DM252/DM254 are multipurpose Handheld meters. With their extended functions they resemble high-value bench-top multimeters.

The DM251/DM252/DM254 are designed for safety. High energy fuses, spark gaps, positive temperature coefficient thermistors and fusible resistors provide protection from overloads and high voltage transients.

The DM254 is a true-rms meter for making accurate measurements even on nonsinesoidal waveforms.

The DM251/DM252/DM254 have a three year warranty.

TD

Call Direct – Product available within 24 hours, (through TekDirect only). Call 1-800-426-2200. Also available through an Authorized Tektronix Distributor (listed on page 540).

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

Handheld Multimeters

DM250 DM251 DM252 DM253 DM254

STANDARD SPECIFICATIONS

	DM250	DM251	DM252/DM254
DC Volts			
Ranges	200 mV, 2 V, 20 V, 200 V, 1000 V	400 mV, 4 V, 40 V, 400 V, 1000 V	400 mV, 4 V, 40 V, 400 V, 1000 V
Accuracy	±(0.5% of reading + 1 count)	All ranges: ±(0.3% of reading +2 counts) Except 400 mV range: ±(0.3% of reading +2 counts)	All ranges: ±(0.1% of reading +2 counts); except 400 mV range: ±(0.3% of reading +2 counts)
Input Resistance	10 MΩ	10 MΩ, paralleled by < 100 pF	10 MΩ, paralleled by < 100 pF
Overload Protection	1100 V (DC or peak to peak)	1100 V (DC or peak to peak)	1100 V (DC or peak to peak)
Resolution	See Table 1 on page 374	See Table 1 on page 375	See Table 1 on page 375
AC Volts			
Ranges	2 V, 20 V, 200 V, 750 V	400 mV, 4 V, 40 V, 400 V, 750 V	400 mV, 4 V, 40 V, 400 V, 750 V (DM254 True RMS)
Accuracy (50-60 Hz)	±(1.25% of reading +5 counts)	±(0.7% of reading +5 counts)	±(0.5% of reading +5 counts)
Input Resistance	10 MΩ, paralleled by < 100 pF	10 MΩ, paralleled by < 100 pF	10 MΩ, paralleled by < 100 pF
Overload Protection	1100 V (DC or peak to peak)	1100 V (DC or peak to peak)	1100 V (DC or peak to peak)
Resolution	See Table 1 On page 374	See Table 1 on page 375	See Table 1 on page 375
DC Current			
Ranges	200 µA, 20 mA, 200 mA, 2 A, 10 A	4 mA, 40 mA, 400 mA, 10 A	4 mA, 40 mA, 400 mA, 10 A
Accuracy	200 µA, 20 mA, 200 mA: ±(0.75% of reading +1 count); 2 A, 10 A: ±(1.5% of reading +3 counts)	4 mA, 40 mA, 400 mA: ±(0.4% of reading +2 counts); 10 A: ±(0.8% of reading +4 counts)	4 mA, 40 mA, 400 mA: ±(0.4% of reading +2 counts); 10 A: ±(0.8% of reading +4 counts)
Input Resistance	1 KΩ TO 0.01 Ω (varies with range)		
Overload Protection	0-2 A range: 3 A (600 V) fast-blow fuse; 0-10 A range: unfused	0-10 A range: 15 A (600 V) IR 100 KA fuse Other ranges: 1 A (600 V) IR 10 KA fuse	0-10 A range: 15 A (600 V) IR 100 KA fuse; Other ranges: 1 A (600 V) IR 10 KA fuse
Resolution	See Table 2 on page 374	See Table 2 on page 375	See Table 2 on page 375
Burden Voltage	0-2 A and 0-10 A range: 900 mV max; All other ranges: 600 mV max	0-10 A range: 1 V max; Other ranges: 800 mV max	0-10 A range: 1 V max; Other ranges: 800 mV max
AC Current			
Ranges	200 µA, 20 mA, 200 mA, 2 A, 10 A	4 mA, 40 mA, 400 mA, 10 A	4 mA, 40 mA, 400 mA, 10 A
Accuracy	200 µA, 20 mA, 200 mA: ±(1.5% of reading +3 counts); 2 A, 10 A: ±(2.5% of reading +5 counts)	4 mA, 40 mA, 400 mA: ±(1.0% of reading +5 counts); 10 A: ±(1.0% of reading +5 counts)	4 mA, 40 mA, 400 mA: (DM254 True RMS) 40 Hz to 1 KHz, ±(1% of reading +5 counts) 4 mV to 400 mV, ±(0.6% of reading +5 counts), DM254
Input Resistance	1 kΩ to 0.01 Ω (varies with range)		
Overload Protection	0-2 A range: 3 A (600 V) fast-blow fuse; 0-10 A range: unfused	0-10 A range: 15 A (600 V) IR 100 KA fuse Other ranges: 1 A (600 V) IR 10 KA fuse	0-10 A range: 15 A (600 V) IR 100 KA fuse; Other ranges: 1 A (600 V) IR 10 KA fuse
Resolution	See Table 2 on page 374	See Table 2 on page 375	See Table 2 on page 375
Burden Voltage	0-2 A and 0-10 A range: 900 mV max; All other ranges: 600 mV max	0-10 A range: 1 V max; Other ranges: 800 mV max	0-10 A range: 1 V max; Other ranges: 800 mV max
Resistance			
Ranges	200 Ω, 2 kΩ, 20 kΩ, 200 kΩ, 2 MΩ, 20 MΩ	400 Ω, 4 kΩ, 40 kΩ, 400 kΩ, 4 MΩ, 40 MΩ	400 Ω, 4 kΩ, 40 kΩ, 400 kΩ, 4 MΩ, 40 MΩ
Accuracy (relative mode)	See Table 3 on page 374	See Table 3 on page 375	See Table 3 on page 375
Overload Protection	500 VDC / AC rms, all ranges	600 VDC / AC rms	600 VDC / AC rms
Resolution	See Table 4 on page 374	See Table 4 on page 375	See Table 4 on page 375
Max. Test Current	See Table 5 on page 374	See Table 5 on page 375	See Table 5 on page 375
Test Voltage	Low power Ω - open circuit: 450 mV; High power Ω - open circuit: 900 mV	Open circuit: 450 mV	Open circuit: 450 mV

Continued on next page.

DM250 DM251 DM252 DM253 DM254 Handheld Multimeters

	DM250	DM251	DM252/DM254
Capacitance			
Ranges	—	0-40 µF in 5 ranges	0-40 µF in 5 ranges
Resolution	—	See Table 6 on page 375	See Table 6 on page 375
Accuracy	—	4 nF range in relative mode: ±(1% of reading + 40 counts); Other ranges: ±(1% of reading + 4 counts) for 40 pF to 20 µF, ±(5% of reading + 8 digits) for ≥ 20 µF	4 nF range in relative mode: ±(1% of reading + 40 counts); Other ranges: ±(1% of reading + 4 counts) for 40 pF to 20 µF, ±(5% of reading + 8 digits) for ≥ 20 µF
Frequency			
Ranges	—	0 - 1 MHz in 5 ranges	0 - 1 MHz in 5 ranges
Resolution	—	See Table 7 on page 375	See Table 7 on page 375
Accuracy	—	1 MHz range: ±(0.5% of reading +4 counts); Other ranges: ±(0.1% of reading +4 counts)	1 MHz range: ±(0.5% of reading +4 counts); Other ranges: ±(0.1% of reading +4 counts)
Input protection	—	600 VDC / AC rms	600 VDC / AC rms
Diode Test			
Max. Test Current	1.5 mA	0.6 mA	0.6 mA
Max. Open Circuit Voltage	3.3 V	3.6 V	3.6 V
Resolution	1 mV	1 mV	1 mV
Accuracy	±(1.5% +5 counts)	±(1.0% +2 counts)	±(1.0% +2 counts)
Overload Protection	500 VDC / AC rms	600 VDC / AC rms	600 VDC / AC rms
Continuity Check	Buzzer sounds if circuit resistance < 50 Ω	Buzzer sounds if circuit resistance ≤ 30 Ω	Buzzer sounds if circuit resistance ≤ 30 Ω
Adapt Range			
Display	—	10 counts per mVDC	10 counts per mVDC
Accuracy	—	±(0.3% of reading +4 counts)	±(0.3% of reading +4 counts)
Safety			
	UL Listed	Designed to UL 1244 specs Designed to IEC 348 Class II specs	Designed to UL 1244 specs Designed to IEC 348 Class II specs
Environmental			
Power Requirements	9 V battery, NEDA 1604, JIS 006P, or IEC 6F22	IEC LR03, AM4, or AAA (1.5V) X2	IEC LR03, AM4, or AAA (1.5V) X2 One Std. 9 V: IEC 6F22, 006P or NEDA (DM254)
Battery Life	500 hours typical (alkaline)	1200 hours typical (alkaline)	1200 hours typical (alkaline) 500 hours (DM254)
Ambient Temperature			
Operating:	0°C to 50°C	–10°C to 50°C	–10°C to 50°C
Nonoperating:	(w/o battery) 20°C to +60°C	–30°C to 60°C	–30°C to 60°C
Relative Humidity (operating and nonoperating)	0% to 80%	0% to 80%	0% to 80%
Shock and Vibration	Per MIL-T-28800 for a Class 2	Per MIL-T-28800 for a Class 2	Per MIL-T-28800 for a Class 2
Dust/Water Protection IP Rating	IP 64	IP 64	IP 64
Maximum Voltage to Earth	AC 750 Vrms, DC 1000 V	1000 Vp-p from any terminal	1000 Vp-p from any terminal
Physical Characteristics			
Size (W x L x D) (w/o holster)	84 mm x 175 mm x 31 mm	86 mm x 185 mm x 32 mm 3.4 in. x 7.3 in. x 1.3 in.	86 mm x 185 mm x 32 mm 3.4 in. x 7.3 in. x 1.3 in.
Weight (including battery)	Approx. 0.34 kg (0.75 lb.)	Approx. 0.37 kg (0.82 lb); with holster 0.6 kg (1.32 lb)	Approx. 0.37 kg (0.82 lb); with holster 0.6 kg (1.32 lb)

DM250 Table 1 – DC & AC Volts: Resolution

Range	DC Volts	AC Volts
200 mV	100 µV	
2 V	±1 mV	±1 mV
20 V	±10 mV	±10 mV
200 V	±100 mV	±100 mV
1000 V	±1 V	±1 V

DM250 Table 2 – DC & AC Current: Resolution

Range	DC Currents	AC Currents
200 µA	0.1 µA	0.1 µA
20 mA	10 µA	10 µA
200 mA	100 µA	100 µA
2 A	1 mA	1 mA
10 A	10 mA	10 mA

DM250 Table 3 – Resistance: Accuracy

Range	Accuracy
200 Ω	±(0.75% of reading + 1 count)
2 kΩ	±(0.75% of reading + 1 count)
20 kΩ	±(0.75% of reading + 1 count)
200 kΩ	±(0.75% of reading + 1 count)
2 MΩ	±(1.0% of reading + 3 counts)
2 to 20 MΩ	±(1.5% of reading + 5 counts)

DM250 Table 4 – Resistance: Resolution

Range	Resolution
200 Ω	0.1 Ω
2 kΩ	1 Ω
20 kΩ	10 Ω
200 kΩ	100 Ω
2 MΩ	1 kΩ
2 to 20 MΩ	10 kΩ

DM250 Table 5 – Resistance: Maximum Test Current

Range	Max. Test Current
200 Ω	2.5 mA
2 kΩ	250 µA
20 kΩ	50 µA
200 kΩ	5 µA
2 MΩ	500 nA
2 to 20 MΩ	50 nA

Handheld Multimeters

DM250 DM251 DM252 DM253 DM254

DM251/DM252/DM254
Table 1 – DC & AC Volts: Resolution

Range	DC Volts	AC Volts
400 mV	±100 µV	±100 µV
4 V	±1 mV	±1 mV
40 V	±10 mV	±10 mV
400 V	±100 mV	±100 mV
750 V	n/a	±1 V
1000 V	±1 V	n/a

DM251/DM252/DM254
Table 2 – DC & AC Current: Resolution

Range	DC Currents	AC Currents
4 mA	1 µA	1 µA
40 mA	10 µA	10 µA
400 mA	100 µA	100 µA
10 A	1 mA	1 mA

DM251/DM252/DM254
Table 3 – Resistance: Accuracy

Range	Accuracy
400 Ω	±0.4% of reading ±4 counts
4 kΩ	±0.4% of reading ±2 count
40 kΩ	±0.4% of reading ±2 count
400 kΩ	±0.4% of reading ±2 count
4 MΩ	±0.6% of reading ±3 counts
40 MΩ	±1.5% of reading ±5 counts

DM251/DM252/DM254
Table 4 – Resistance: Resolution

Range	Resolution
400 Ω	0.1 Ω
4 kΩ	1 Ω
40 kΩ	10 Ω
400 kΩ	100 Ω
4 MΩ	1 kΩ
40 MΩ	10 kΩ

DM251/DM252/DM254
Table 5 – Resistance: Maximum Test Current

Range	Max Test Current
400 Ω	0.3 mA
4 kΩ	200 µA
40 kΩ	100 µA
400 kΩ	10 µA
4 MΩ	1000 nA
40 MΩ	100 nA

DM251/DM252/DM254
Table 6 – Capacitance: Resolution

Range	Resolution
4 nF	1 pF
40 nF	10 pF
400 nF	100 pF
4 µF	1 nF
40 µF	10 nF

STANDARD SPECIFICATIONS

	DM253
Capacitance	
Ranges	0 - 20 mF in 9 ranges
Resolution	See Table 1 on page 376
Accuracy	See Table 1 on page 376
Test Frequencies by Ranges	200 pF, 2 nF, 20 nF, 200 nF, 2 µF: 820 Hz, 20 µF: 82 Hz 200 µF, 2000 µF, 20 mF: 8.2 Hz
Test Voltage	3.2 V peak maximum ("+" input terminal voltage is always higher than "-" input terminal)
Overload protection from charged capacitors	>50 VDC by 0.25 A (250 V) fast-blow fuse
Resistance	
Ranges	200 Ω, 2 kΩ, 20 kΩ, 200 kΩ, 2 MΩ, 20 MΩ
Accuracy	See Table 3 on page 376
Overload Protection	500 VDC / AC rms, all ranges
Resolution	See Table 4 on page 376
Max. Open Circuit Voltage	200 Ω range: 3.2 V, 2 kΩ to 20 MΩ ranges: 0.5 V
Diode Test	
Max. Test Current	1.5 mA
Max. Open Circuit Voltage	3.2 V
Accuracy	± 1.5% of reading ± 5 counts
Resolution	1 mV
Overload Protection	500 V AC / DC rms maximum
SCR Test	
Test result	Go / No-go
Transistor hFE Test (PNP or NPN)	
hFE Range	1 – 1000
hFE Vce	≈ 3 V
hFE Base Current	≈ 10 µA
Transistor Leakage ICEO Test	
Range	10 nA – 20 µA
Battery Test	
Load: Current (Display reading is approx. battery voltage)	9 V battery: 15 mA 1.5 V cell: 150 mA 1.55 V button cell: 0.8 mA
LED Test	
Max. Test Voltage	3.2 V
Test Current Ranges	0 – 2 mA; 0 – 10 mA
LED Lighted Test	Display reading [a] forward voltage to LED
Safety	Designed to UL 1244 specifications
Environmental	
Power Requirements	9 V battery NEDA 1604, JIS006P, IEC 6F22
Battery Life	Approx. 200 Hours (alkaline)
Ambient Temperature	
Operating	0°C to +50°C
Nonoperating	–20°C to +60°C
Relative Humidity (Operating and Nonoperating)	0% to 80%
Physical Characteristics	
Size (W x L x D)	84 mm x 175 mm x 31 mm 3.3 in. x 1.2 in. x 6.9 in.
Weight (net)	Approx. 0.33 kg. (0.73 lb.)

DM251/DM252/DM254
Table 7 – Frequency: Resolution

Range	Resolution
100 Hz	0.01 Hz
1 kHz	0.1 Hz
10 kHz	1 Hz
100 kHz	10 Hz
1 MHz	100 Hz

Continued on next page.

DM250 DM253
DM251 DM254
DM252

Handheld Multimeters

DM253 Table 1 – Capacitance: Resolution

Range	Resolution
200 pF	0.1 pF
2 nF	1 pF
20 nF	10 pF
200 nF	100 pF
2 mF	1 nF
20 mF	10 nF
200 mF	100 nF
2000 mF	1 mF
20 mF	10 mF

DM253 Table 2 – Capacitance: Accuracy

Range	Accuracy
200 pF	± 0.5% of reading ± 6 counts + 0.5 pF (for this range only)
2 nF	± 0.5% of reading ± 5 counts
20 nF	± 0.5% of reading ± 5 counts
200 nF	± 0.5% of reading ± 5 counts
2 mF	± 0.5% of reading ± 5 counts
20 mF	± 0.5% of reading ± 5 counts
200 mF	± 0.5% of reading ± 5 counts
2000 mF	± 1.0% of reading ± 1 count
20 mF	± 1.5% of reading ± 1 count

DM253 Table 3 – Resistance: Accuracy

Range	Accuracy
200 Ω	± 0.5% of reading ± 4 counts
2 kΩ	± 0.5% of reading ± 1 count
20 kΩ	± 0.5% of reading ± 1 count
200 kΩ	± 0.5% of reading ± 1 count
2 MΩ	± 0.5% of reading ± 1 count
20 MΩ	± 2.0% of reading ± 1 count

DM253 Table 4 – Resistance: Resolution

Range	Resolution
200 Ω	0.1 Ω
2 kΩ	1 Ω
20 kΩ	10 Ω
200 kΩ	100 Ω
2 MΩ	1 kΩ
2 to 20 MΩ	10 kΩ

TD

Call Direct – Product available within 24 hours, (through TekDirect only). Call 1-800-426-2200. Also available through an Authorized Tektronix Distributor (listed on page 540).

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

ORDERING INFORMATION

DM251
Digital Multimeter ..... TD **$179**
Includes: One pair of test leads (196-3359-00); Instruction Manual (070-8375-01); Holster (118-3732-00).

DM252
Digital Multimeter ..... TD **$199**
Includes: One pair of test leads (196-3359-00); Instruction Manual (070-8375-01); Holster (118-3732-00).

DM254
Digital Multimeter ..... TD **$219**
Includes: One pair of test leads (196-3359-00); Instruction Manual (070-8375-01); Holster (118-3732-00).

OPTIONAL ACCESSORIES
Soft Carrying Case – Fits with holster removed
Order 118-8338-00. ..... **$15**

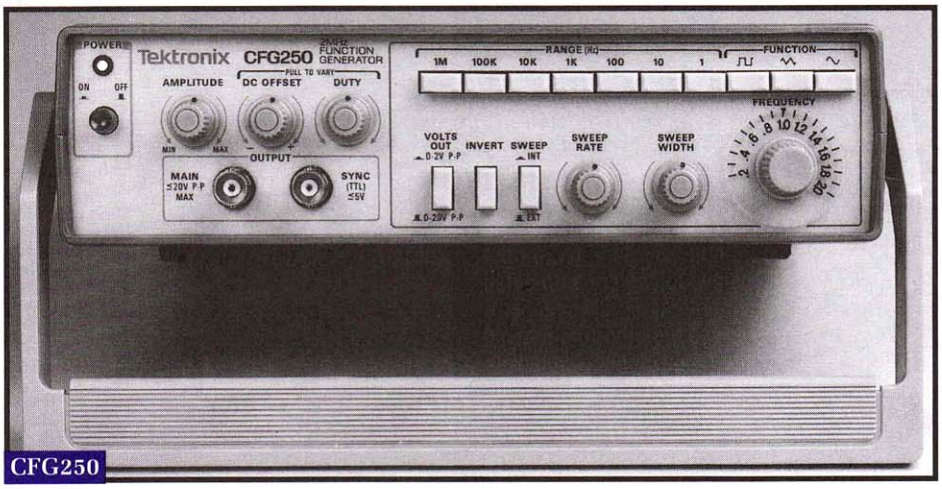
Fuse, 600 V – 1 Amp. Order 159-0337-00 ..... **$4.00**
15 Amp. Order 159-0287-00 ..... **$7.75**

DM250
Digital Multimeter ..... TD **$135**
Includes: Right angle test leads (012-1381-00); 9 V battery; Operator's Manual (070-8216-00); Holster (118-8733-00)

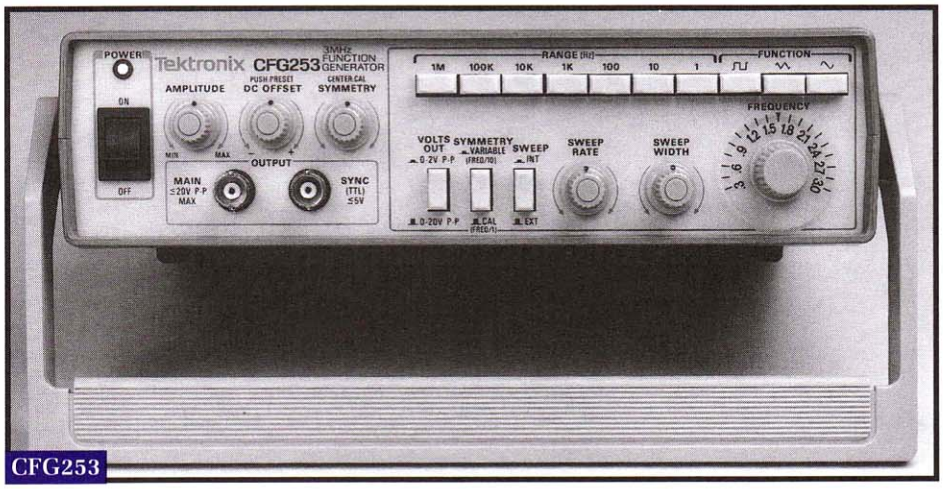
DM253
Component Checker ..... TD **$115**
Includes: Right angle test leads (012-1382-00); 9 V battery; Operator's Manual (070-8217-00)

OPTIONAL ACCESSORIES
Holster – (DM253) Order 118-8733-00 ..... **$15**
Soft Carrying Case – Order 118-8338-00 ..... **$15**
Fuse – (DM250) Order 159-5001-00 ..... **$3.00**
Fuse – (DM253) Order 159-0183-00 ..... **$0.70**

Function Generators



CFG250



CFG253

CFG250

The CFG250 2 MHz Function Generator produces sine, square, and triangle waves, and TTL signals for testing amplifiers, filters, and digital circuits. Its sweep function can be controlled internally or with an external signal level. Duty cycle, DC offset, sweep rate, sweep width and amplitude are all operator controlled.

CFG253 Function Generator

Applications for the CFG253 include testing and calibration of audio, ultrasonic, and servo systems. The CFG253 sweep function can be controlled internally or with an external DC level. Duty cycle, DC offset, sweep rate, sweep width and amplitude are user controllable.

CFG250

- 0.2 Hz to 2 MHz
- Square, Triangle and Sine Waves; TTL Output
- 20 dB Attenuator
- Internal or External Frequency Sweep
- Variable Duty Cycle
- One Year Warranty
- UL Listed, CSA Certified

CFG253

- 0.03 Hz to 3 MHz Function Generator
- Square, Triangle, Sine Wave and TTL Output
- 20 dB Attenuator
- Variable Symmetry (20-80%)
- Internal or External Frequency Sweep

CFG280

- 0.01 Hz to 11 MHz (uncalibrated)
- 0.01 Hz to 11 MHz (calibrated)
- Square, Triangle, SineWave and TTL Output
- 20 dB Attenuator
- 1 Hz to 100 MHz Counter
- External Gate Input
- VCF (FM) Input
- AM 0-100% Input for External SineWave
- Internal or External Frequency Sweep
- Variable Symmetry 95/5 Fixed (Pulse and Ramp)

Function Generators for Testing and Calibration of Audio, Ultrasonic, and Servo Systems

TD

Call Direct – Product available within 24 hours, (through TekDirect only). Call 1-800-426-2200. Also available through an Authorized Tektronix Distributor (listed on page 540).

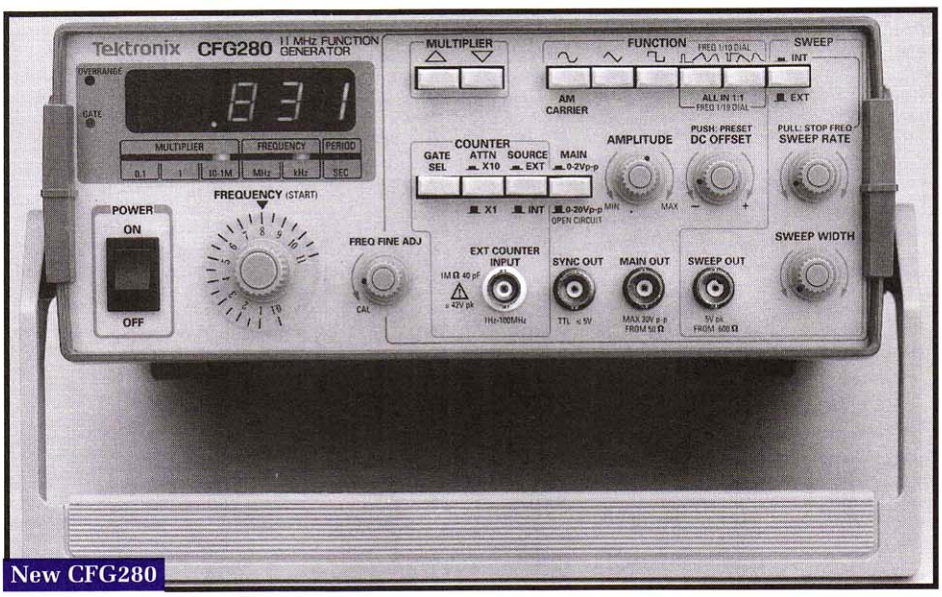
To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

CFG250 CFG253 CFG280 Function Generators

STANDARD SPECIFICATIONS

	CFG253	CFG250	CFG280
Waveform Outputs	Square wave, sine wave triangle wave, TTL pulse, sweep functions for all outputs	Square wave, sine wave, triangle wave, TTL pulse, sweep functions for all outputs	Square wave, sine wave, triangle wave, TTL pulse, sweep functions for all outputs
Ranges	1.0 Hz to 1.0 MHz in 7 ranges; Low range extension with Freq/10 function (0.1 Hz to 100 kHz)	1.0 Hz to 1.0 MHz in 7 ranges	0.1 Hz (calibrated) to 11 MHz in 8 ranges
Frequency Multiplier	Variable from 0.3 to 3.0 times the selected frequency range	Variable from 0.2 to 2.0 times the selected frequency range	Variable from 0.1 to 1 (uncalibrated) 1 to 11 (calibrated)
Dial Accuracy	±5% of full scale	±5% of full scale	±5% of full scale from 0.1 Hz to 10 MHz
Sine Wave Distortion	<1% (10 Hz to 100 kHz)	<1% (10 Hz to 100 kHz)	<1% (10 Hz to 100 kHz) −30 dB at all other frequencies
Triangle Wave Linearity	20 Hz to 200 kHz: ≥99%; 200 kHz to 3 MHz: ≥97%	20 Hz to 200 kHz: ≥99%; 200 kHz to 2 MHz: ≥97%	0.1 Hz to 110 kHz: ≥99%; 110 kHz to 1 MHz: ≥97%, 1MHz to 11 MHz ≥95%
Square Wave Response	≤100 ns rise/fall time, maximum output into 50 Ω load	≤100 ns rise/fall time, maximum output into 50 Ω load	≤25 ns rise/fall time, maximum output into 50 Ω load
Main Output Amplitude	0-20 Vp-p: 100 mV to 20 Vp-p (open circuit), 50 mV to 10 Vp-p (50 Ω load); 0-0.2 Vp-p: 10 mV to 2 Vp-p (open circuit), 5 mV to 1 Vp-p (50 Ω load)	0-20 Vp-p: 100 mV to 20 Vp-p (open circuit), 50 mV to 10 Vp-p (50 Ω load); 0-0.2 Vp-p: 10 mV to 2 Vp-p (open circuit), 5 mV to 1 Vp-p (50 Ω load)	0-20 Vp-p: 200 mV to 20 Vp-p (open circuit); 100 mV to 10 Vp-p (50 Ω load) 0-0.2 Vp-p: 20 mV to 2 Vp-p (open circuit); 10 mV to 1 Vp-p (50 Ω load)
Attenuator	20 dB attenuator	20 dB attenuator	20 dB attenuator
SYNC/TTL Output	TTL output level, rise <25 ns (20 TTL load) ≥3 V peak	TTL output level, rise <25 ns (20 TTL load) ≥3 V peak	<25 ns rise/fall time, maximum output into 50 Ω load
Main Output Impedance	50 Ω ± 10%	50 Ω ±10%	50 Ω ±10%
DC Offset (continuously variable)	±10 V minimum open circuit ; ±5 V minimum into 50 Ω load	±10 V minimum open circuit; ±5 V minimum into 50 Ω load	±10 V minimum open circuit; ±5 V minimum into 50 Ω load
Symmetry/Duty Cycle	5 to 1 minimum symmetry change	5 to 1 minimum symmetry change	95/5 fixed (pulse and ramp)
Internal Variable Sweep Rate	0.5 Hz to 50 Hz	0.5 Hz to 50 Hz	0.5 Hz to 50 Hz
Sweep Width	Variable from 1:1 to 100:1 with frequency dial set at maximum	Variable from 1:1 to 100:1 with frequency dial set at maximum	Variable from 1:1 to 100:1 with frequency dial set at maximum
External Voltage-Controlled Variable Sweep Range (10 kΩ input)	100:1 minimum for 0 to +10 VDC input with frequency control set at maximum	100:1 minimum for 0 to +10 VDC input with frequency control set at maximum	100:1 minimum for 0 to ±10 VDC input with frequency control set at 0.1 or 11
External Gate Input	—	—	+2 V to 15 V (~1 KΩ Impedance); Fixed 0° Start Phase
Pulse and Ramp Frequency	—	—	1/10 dial frequency
VCF (FM) Input	—	—	±10 V input shifts frequency ≥100:1 up or down with dial set at 0.1 or 11 respectively
AM	—	—	0 – 100%, DBSC, external sine wave only
Counter Specifications			
Frequency Range (AC coupled)	—	—	1 Hz to 100 MHz
Sensitivity	—	—	30 mV rms from 1 Hz to 50 MHz; 50 mV rms from 50 MHz to 100 MHz:
Attenuation	—	—	Selectable: 1X, 10X
Max Input Voltage	— —	—	1 Hz to 5 MHz 42 V peak, 5 MHz to 100 MHz 4.9 V peak
Impedance	—	—	1.0 MΩ, paralleled by ≤40 pF
Period Range/Resolution	—	—	1 ms to 60 s/1 ms
Counter Time Base Stability			
Temperature Stability	—	—	±0.001% (±10 ppm) from 0° to 40°C
Line Voltage Stability of Oscillator	—	—	≤ ±1.0 ppm with 10% line voltage variation
Aging Rate	—	—	≤ ±10 ppm/yr
Crystal Frequency	—	—	10 MHz
Counter Accuracy			
Frequency	—	—	±(time base error + 1 count)
Period	—	—	±(time base error + 1 count + trigger error)
Power Requirements			
Range Line Voltage	90 to 110 VAC, 108 to 132 VAC 198 to 242 VAC, 216 to 250 VAC	90 to 110 VAC, 108 to 132 VAC 198 to 242 VAC, 216 to 250 VAC	90 to 110 VAC, 108 to 132 VAC 198 to 242 VAC, 216 to 250 VAC
Line Frequency	50 to 60 Hz	50 to 60 Hz	50 to 60 Hz
Maximum Power Consumption	21 VA, 18 W	20 VA, 17 W	50 VA, 42 W
Safety	UL Listed, CSA Certified	UL Listed, CSA Certified	ETL
Physical Characteristics			
Size (W x H x D)	240 mm x 64 mm x 190 mm 9.46 in. x 2.53 in. x 7.49 in.	240 mm x 64 mm x 190 mm 9.46 in. x 2.53 in. x 7.49 in.	240 mm x 1090 mm x 190 mm 9.46 in. x 3.9 in. x 7.49 in.
Weight	1.7 kg (3.7 lb)	1.7 kg (3.7 lb)	2.7 kg (5.9 lb.)

Function Generators



New CFG280

CFG280 11 MHz Function Generator With Counter

The CFG280 combines an 11 MHz Function Generator, which produces sine, square, and triangle waves, plus TTL signals, with a 100 MHz Frequency Counter. The onboard counter allows the operator to set the frequency output of the function generator precisely. This versatile instrument conserves both benchtop and budget by combining the two capabilities.

Applications include manufacturing testing of electronic products and the repair and calibration of audio equipment, servomechanisms, and amplifiers.

ORDERING INFORMATION

CFG250
2 MHz Function Generator ..... TD **$365**
Includes: Operator's Manual (070-6738-00); US power cord (standard) and one year warranty.

CFG253
3 MHz Function Generator ..... TD **$415**
Includes: Operator's Manual (070-8362-00); US Power Cord (standard) and one year warranty.

CFG280
Function Generator w/counter ..... TD **$995**
Includes: Instruction Manual (070-8559-00); US power cord (standard) and one year warranty.

INTERNATIONAL POWER PLUG OPTIONS
Opt. A1 – Universal Euro, 220 V/50 Hz ..... **NC**
Opt. A2 – UK, 240 V/50 Hz ..... **NC**
Opt. A3 – Australia, 240 V/50 Hz ..... **NC**
Opt. A4 – North American, 240 V/60 Hz ..... **NC**
Opt. A5 – Switzerland, 220 V/50 Hz ..... **NC**

WARRANTY-PLUS SERVICE OPTIONS
Opt. M7 – Calibration Service
CFG 250 ..... **+$58**
CFG 253 ..... **+$60**
CFG 280 ..... **+$120**
Opt. M9 – Repair Protection
CFG 250 ..... **+$66**
CFG 253 ..... **+$65**
CFG 280 ..... **+$80**

OPTIONAL ACCESSORIES
BNC Cables, Probes, etc. See page 407 for full line of accessories

TD
Call Direct – Product available within 24 hours, (through TekDirect only). Call 1-800-426-2200. Also available through an Authorized Tektronix Distributor (listed on page 540).

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99

CFC250 CDC250 CMC250 CMC251 Counters

Multifunction Counter for use in high frequency systems.

Universal Counter with temperature compensated time base to ensure performance in changing ambient temperature.

CDC250

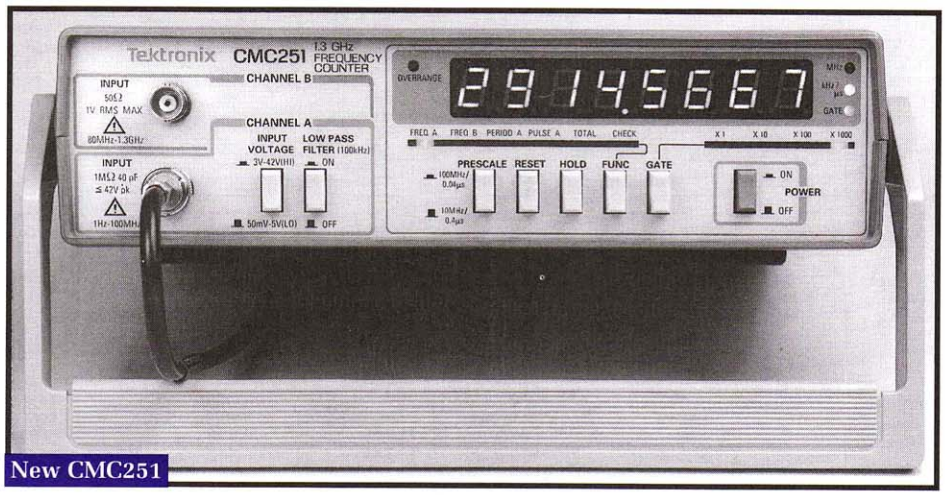
- 5 Hz to 175 MHz
- 8 digit LED display: autodecimal measurement unit
- Frequency Ratio
- Time Interval
- Totalize
- UL Listed, CSA Certified

CMC250/CMC251

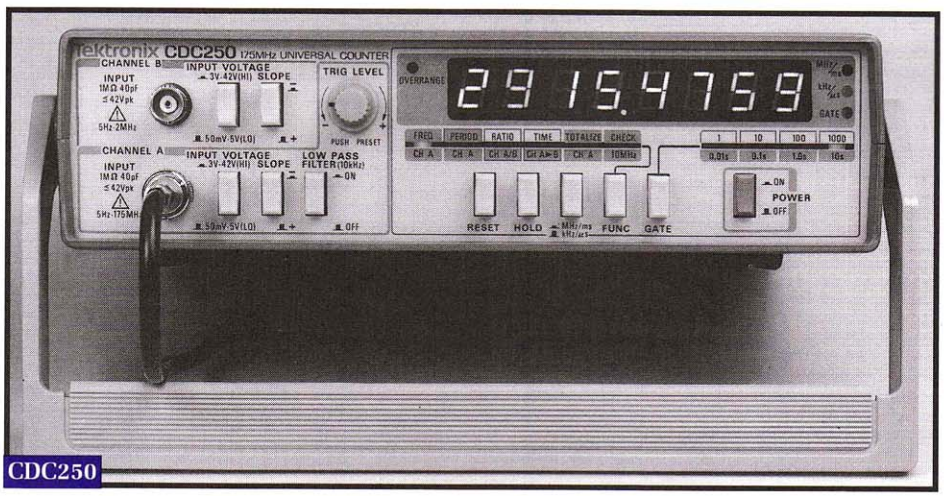
- 5 Hz to 100 MHz (CH 1)
  80 MHz to 1.3 GHz (CH 2)
- Measurements: Frequency, Period Average, Period, Totalize, Self Check
- 8 digit LED display
- Overrange Indication
- Display hold
- Remote start-stop
- UL Listed, CSA Certified
- Time Base ±1 ppm (CMC251)

CFC250

- 5 Hz to 100 MHz (1 Hz Res.)
- 8 Digit Display
- Switchable Input Sensitivity
- Overrange Indicator
- 100 kHz Lowpass Filter
- UL Listed, CSA Certified



New CMC251



CDC250

CMC251

The CMC251 1.3 GHz Multifunction Counter measures the frequency of sine, square and triangle waves from 5 Hz to 1.3 GHz. The CMC251 also provides period, totalize, and pulse width measurements. The counter has two input channels. Channel A is a standard 1 MΩ input for frequency measurements up to 100 MHz. Channel B is a 50 Ω terminated input for use in high-frequency systems. This counter will be of interest to radio amateurs because of its ability to measure high-frequency systems. The time base stability is ±1 part per million.

CDC250

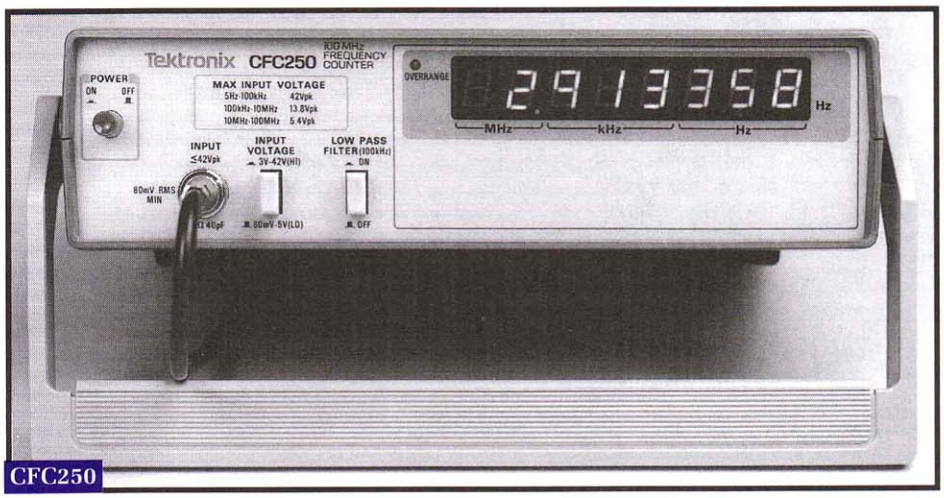
The CDC250 175 MHz Universal Counter counts frequency of sine, square and triangle waves from 5 Hz to 175 MHz at input levels from 20 mV to 42 V peak. The CDC250 also provides period measurements, frequency ratio, time interval and totalize measurement functions. The CDC250 has a temperature compensated time base to ensure performance in changing ambient temperature. Service technicians will find the CDC250 useful as a standard to calibrate other equipment.

TD

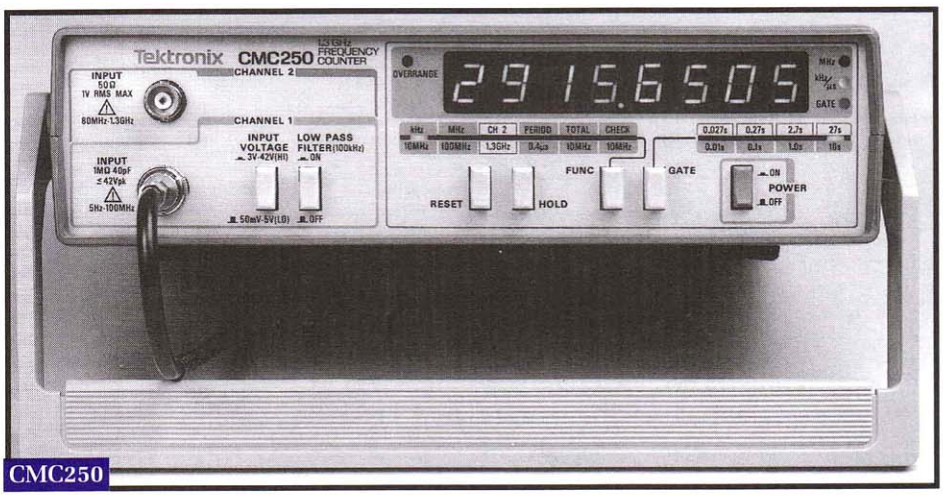
Call Direct – Product available within 24 hours, (through TekDirect only). Call 1-800-426-2200. Also available through an Authorized Tektronix Distributor (listed on page 540).

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99

Counters



CFC250



CMC250

CFC250

The CFC250 Frequency Counter counts the frequency of sine, square and triangle waves from 5 Hz to 100 MHz at input levels from 30 mV to 42 V peak. Applications include the adjustment, testing and repair of items including audio instruments, AM/FM radios, televisions, CB radios, computer clocks, amateur radios and musical instruments.

CMC250

The CMC250 1.3 GHz Multifunction Counter measures the frequency of sine, square and triangle waves from 5 Hz to 1.3 GHz. The CMC250 also provides period and totalize measurements. The counter has two input channels: Channel 2 is a special 50 Ω terminated input for use in high frequency systems, and Channel 1 is a standard 1 MΩ input for frequency measurements up to 100 MHz. This counter will be of special interest to radio amateurs because of its ability to measure high frequency systems.

STANDARD SPECIFICATIONS

	CMC251	CDC250
Channel A		
Frequency Range (AC coupled)	1 Hz to 100 MHz	5 Hz to 175 MHz
Sensitivity	20 mV rms from 1 Hz to 30 MHz; 50 mV rms from 30 MHz to 100 MHz	kHz/ms mode: 20 mV rms from 5 Hz to 10 MHz; MHz/µs mode: 50 mV rms from 5 MHz to 125 MHz; 100 mV rms from 125 MHz to 150 MHz; 150 mV rms from 150 MHz to 175 MHz
Attenuation	3 V to 42 V (Hi); 50 mV to 5 V (Lo)	3 V to 42 V (Hi); 50 mV to 5 V (Lo)
Max Input Voltage	5 Hz to 5 MHz: 42 V peak; 5 MHz to 100 MHz: 4.9 V peak	5 Hz to 5 MHz: 42 V peak; 5 MHz to 175 MHz: 4.9 V peak
Low Pass Filter	-3 dB at 100 kHz	-3 dB at 10 kHz
Impedance	1.0 MΩ, paralleled by 40 pF	1.0 MΩ, paralleled by 40 pF
Channel B		
Frequency Range	80 MHz to 1.3 GHz, AC coupled	5 Hz to 2 MHz, AC coupled
Sensitivity	5 mV rms from 80 MHz to 600 MHz; 15 mV rms from 600 MHz to 900 MHz; 35 mV rms from 900 MHz to 1.3 GHz	30 mV rms from 5 Hz to 2 MHz
Impedance	50 Ω	1.0 MΩ, paralleled by 40 pF
Max Input Voltage	1 V rms	42 V peak

Continued on next page.

CFC250 CDC250 CMC250 CMC251 Counters

	CMC251	CDC250
Period		
Range	Direct mode: 0.4 µs to 1.0 s; Prescale mode: 0.04 µs to 1.0 s	0.5 µs to 0.2 s
Resolution	Direct mode: 100 ps to 100 ns; Prescale mode: 10 ps to 10 ns, switchable in four decade steps	100 ps to 100 ns, switchable in four decade steps
Min Pulse Width	Direct mode: 0.2 µs; Prescale mode: 20 ns	250 ns
Frequency Range	Direct mode: 1 Hz to 2.5 MHz; Prescale mode: 1 Hz to 25 MHz	5 Hz to 2 MHz
Events Averaged (N)	Direct mode: 1, 10, 100, 1000 cycles; Prescale mode: 10, 100, 1000, 10000 cycles, selectable by gate setting	1, 10, 100, 1000 cycles, selectable by gate setting
Totalize		
Range	0 to 99,999,999	0 to 99,999,999
Pulse Width		
Range	0.25 µs to 0.5 s	—
Period Range	100 ps to 100 ns, selectable in four decade steps	—
Events Averaged (N)	1, 10, 100, or 1000 cycles, selectable by gate setting	—
Time Base Stability		
Temperature Stability	< ±0.0001% (±1 ppm) from 0°C to 40°C	< ±0.0001% (±1 ppm) from 0° to 40°C
Line Voltage Stability of Oscillator	< ±0.4 ppm with 10% line voltage variation	< ±0.4 ppm with 10% line voltage variation
Aging Rate	≤ ±1 ppm/yr	≤ ±1 ppm/yr
Crystal Frequency	10 MHz, temperature compensated	10 MHz, temperature compensated
Accuracy		
Frequency	±(time base error + 1 count)	±(time base error + 1 count)
Period	±(time base error + 1 count + trigger error)	±(time base error + 1 count + trigger error)
Pulse width	±(time base error + 1 count + trigger error + 10 ns)	—
Plus		
Selectable Slope	No	Yes
Ratio CHA: CHB	No	Yes
Display Hold	Yes	Yes
Remote Start/Stop	No	Yes
Time Interval CHA: CHB	No	Yes
Safety	ETL, CSA Certified	UL Listed, CSA Certified
Environmental Requirements		
Ambient Temperature		
Operating	+10°C to 40°C	0°C 10 +50°C
Nonoperating	–10°C to +60°C	–20°C to 60°C
Relative Humidity		
Operating	0% to 75%	0% to 75%
Nonoperating	0% to 80%	0% to 80%
Power Requirements		
Line Voltage	90 to 110 VAC; 108 to 132 VAC; 198 to 242 VAC; 216 to 250 VAC.	90 to 110 VAC; 108 to 132 VAC; 198 to 242 VAC; 216 to 250 VAC
Line Frequency	50 to 60 Hz	50 to 60 Hz
Maximum Power Consumption	22 V A, 12 W	21 VA, 16 W

STANDARD SPECIFICATIONS

	CMC250	CFC250
Channel A		
Frequency Range (AC coupled)	5 Hz to 100 MHz	5 Hz to 100 MHz
Sensitivity	20 mV rms from 5 Hz to 30 MHz; 50 mV rms from 30 MHz to 100 MHz	30 mV rms from 5 Hz to 30 MHz; 50 mV rms from 30 MHz to 70 MHz 80 mV rms from 70 MHz to 100 MHz
Attenuation	3 V to 42 V (Hi); 50 mV to 5 V (Lo)	3 V to 42 V (Hi); 50 mV to 5 V (Lo)
Max Input Voltage	5 Hz to 5 MHz: 42 V peak; 5 MHz to 100 MHz: 4.9 V peak	5 Hz to 100 kHz: 42 V peak; 100 kHz to 10 MHz: 13.8 V peak; 10 MHz to 100 MHz: 5.4 V peak
Low Pass Filter	-3 dB at 100 kHz	100 kHz
Impedance	1.0 MΩ, paralleled by 40 pF	1.0 MΩ, paralleled by 40 pF
Channel B		
Frequency Range	80 MHz to 1.3 GHz, AC coupled	—
Sensitivity	10 mV rms from 80 MHz to 600 MHz; 25 mV rms from 600 MHz to 900 MHz; 50 mV rms from 900 MHz to 1.3 GHz	—
Impedance	50 Ω	—
Max Input Voltage	1 V rms	—

Continued on next page.

Counters

CMC250 / CMC251 — CFC250 / CDC250

	CMC250	CFC250
Period		
Range	0.4 µs to 0.2 s	—
Resolution	100 ps to 100 ns, switchable in four decade steps	—
Min Pulse Width	250 ns	—
Frequency Range	5 Hz to 2.5 MHz;	—
Events Averaged (N)	1, 10, 100, 1000 cycles, selectable by gate setting	—
Totalize		
Range	0 to 99,999,999	—
Time Base Stability		
Temperature Stability	< ±0.001% (±10 ppm) from 0°C to 40°C	< ±0.001% (±10 ppm) from 0° to 40°C
Line Voltage Stability of Oscillator	< ±1.0 ppm with 10% line voltage variation	< ±1.0 ppm with 10% line voltage variation
Aging Rate	≤ ±10 ppm/yr	≤ ±10 ppm/yr
Crystal Frequency	CH A: 10 MHz; CH B: 3.90625 MHz	3.579545 MHz
Accuracy		
Frequency	±(time base error + 1 count)	±(time base error + 1 count)
Period	±(time base error + 1 count + trigger error)	—
Plus		
Display Hold	Yes	No
Remote Start/Stop	Yes	No
Safety	UL Listed, CSA Certified	UL Listed, CSA Certified
Physical Characteristics		
Size (W x H x D)	240 mm x 64 mm x 190 mm 9.5 in. x 2.5 in. x 7.5 in.	240 mm x 64 mm x 190 mm 9.5 in. x 2.5 in. x 7.5 in.
Net Weight	1.9 kg (4.2 lb)	1.9 kg (4.2 lb)
Environmental Requirements		
Temperature Range		
Operating	0°C to +40°C	0°C to +50°C
Nonoperating	-20°C to +60°C	-20°C to +60°C
Relative Humidity		
Operating	0% to 75%	0% to 75%
Nonoperating	0% to 80%	0% to 80%
Power Requirements		
Line Voltage	90 to 110 VAC; 108 to 132 VAC; 180 to 220 VAC; 216 to 250 VAC	90 to 110 VAC; 108 to 132 VAC; 180 to 220 VAC; 216 to 250 VAC
Line Frequency	50 to 60 Hz	50 to 60 Hz
Maximum Power Consumption	15 A, 12 W	16 A, 13 W

ORDERING INFORMATION

CFC250
100 MHz Frequency Counter ..... TD **$345**
Includes: Operator's Manual (070-6742-00); US power cord (standard) and one year warranty.

CDC250
175 MHz Universal Counter ..... TD **$525**
Includes: Operator's Manual (070-7999-00); US power cord (standard) and one year warranty.

CMC250
1.3 GHz Frequency Counter ..... TD **$495**
Includes: Operator's Manual (070-6742-00); US power cord (standard) and one year warranty.

CMC251
1.3 GHz Frequency Counter with High Stability Time Base .. TD **$545**
Includes: Instruction Manual (070-8527-00): US power cord (standard) and one year warranty; Recommended Probe P6130, 250 MHz, 10X.

WARRANTY-PLUS SERVICE OPTIONS

Opt. M7 – Calibration Service
CFC250 ..... **+$43**
CDC250 ..... **+$30**
CMC250 ..... **+$30**
CMC251 ..... **+$60**

Opt. M9 – Repair Protection
CFC250 ..... **+$59**
CDC250 ..... **+$60**
CMC250 ..... **+$40**
CMC251 ..... **+$75**

INTERNATIONAL POWER PLUG OPTIONS

Standard – U.S. Power Cord: 120 V, 60 Hz ..... **NC**
Opt. A1 – Universal Euro: 220 V, 50 Hz (020-0859-00) ..... **NC**
Opt. A2 – United Kingdom: 240 V, 50 Hz (020-0861-00) ..... **NC**
Opt. A3 – Australian: 240 V, 50 Hz (020-0861-00) ..... **NC**
Opt. A4 – North American: 240 V, 60 Hz (020-0862-00) ..... **NC**
Opt. A5 – Switzerland: 220 V, 50 Hz (020-0863-00) ..... **NC**

TD
Call Direct – Product available within 24 hours, (through TekDirect only). Call 1-800-426-2200. Also available through an Authorized Tektronix Distributor (listed on page 540).

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

CDM250
DM2510
DM2510G

Digital Multimeters

Digital Multimeters for testing electronic products, power supplies, audio visual equipment, automative electronics, and control systems.

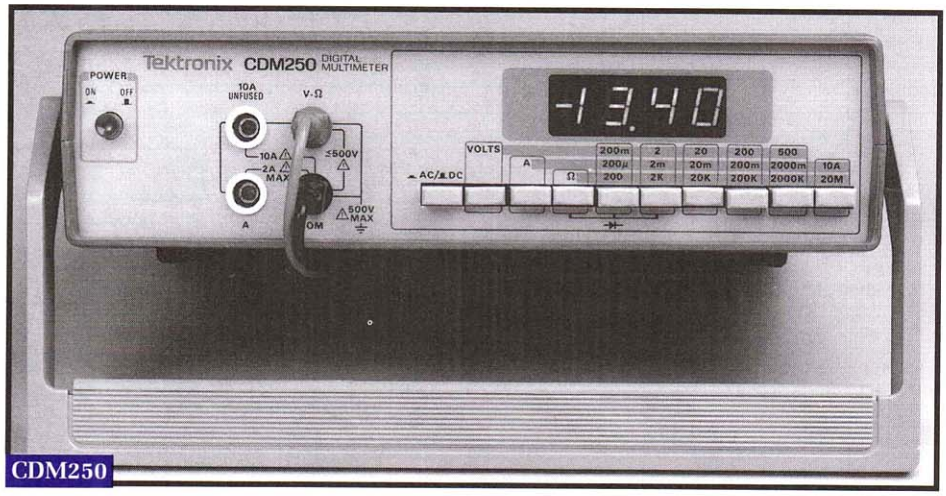
CDM250

Digital Multimeter

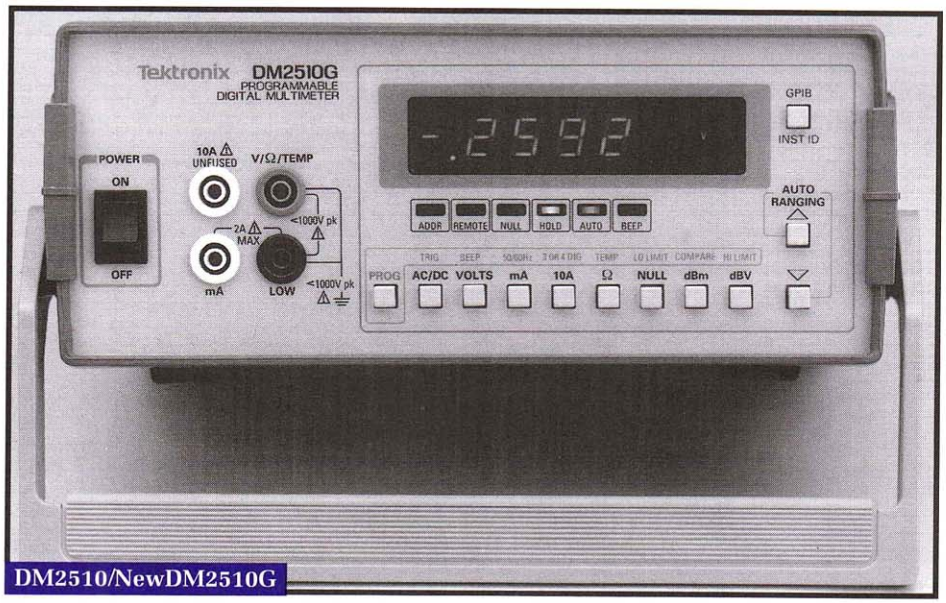
- AC/DC Volts (500 V Range)
- Ohms (20 MΩ Range)
- Current (10 A Range)
- Overload Protection
- UL Listed, CSA Certified

DM2510/DM2510G

- Programmable
- GPIB (DM2510G)
- DC Volts (1000 V Range)
- AC Volts (500 Range, rms)
- dB Function (AC Voltage ranges)
- DC/AC Current (10 A Range)
- Resistance (20 Ω Range
- Temperature
- Autoranging (except temperature)
- Null Function
- Hold Mode
- Trigger Function
- Compare Mode/Beeper Mode (HI to LO Limits)
- Fast and Normal Mode



CDM250



DM2510/NewDM2510G

CDM250

The CDM250 Digital Multimeter displays measurements in digital form on a 3 1/2-digit LED display. Sine wave alternating voltages and currents are displayed in rms values. Test Leads are included.

DM2510 Programmable Digital Multimeter

The DM2510 is a programmable, six-function, autoranging digital multimeter. You can use it to measure DC and AC voltage and current, plus resistance and temperature. It has a NULL function to make measurements with an offset value, plus a HOLD mode and a TRIGGER function. COMPARE mode compares the current measurement with user-selectable high and low limits; a beeper can be set to sound when the measurement is beyond the specified limits.

DM2510G Programmable Digital Multimeter with GPIB Interface

The DM2510G, a programmable six-function autoranging digital multimeter, has a GPIB interface for remote operation and programming. This instrument is for use with a GPIB controller, such as the Tektronix RIC386 or a computer with a GPIB card on board.

Applications include education, design, service and manufacturing. Use for testing electronic products, power supplies, audio visual equipment, automative electronics and control systems.

TD

Call Direct – Product available within 24 hours, (through TekDirect only). Call 1-800-426-2200. Also available through an Authorized Tektronix Distributor (listed on page 540).

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

Digital Multimeters

CDM250
DM2510
DM2510G

STANDARD SPECIFICATIONS

	CDM250	DM2510/G
DC Volts		
Ranges	200 mV, 2 V, 20 V, 200 V, 500 V	*200 mV, 2 V, 20 V, 200 V, 1000 V
Accuracy	±(0.5% of reading +1 count)	See Table 6 on this page
Response Time	3 seconds maximum	<0.3 seconds to 1% of step
Step Response Time	—	<50 ms to 0.05% of step
Input Resistance	10 MΩ	10 MΩ ±0.5%
Max. Input Voltage	500 VDC (DC + peak AC)	LOW to GND, V/Ω/TEMP to GND, and V/Ω/TEMP to LOW: 1000 VDC
CMRR	>100 dB (50/60 Hz)	≥100 dB @ DC, ≥80dB @ 50/60 Hz
NMRR	>50 dB (50/60 Hz)	≥50 dB @ 50/60 Hz (+0.2 Hz)
Max. Resolution	See Table 1 on this page	10 µV
AC Volts		
Ranges	200 mV, 2 V, 20 V, 200 V, 500 V	*200 mV, 2 V, 20 V, 200 V, 500 V (rms)
Accuracy	±(1.0% of reading +4 counts) (18° to 28°C)	See Table 7 on page 386
Response Time	8 seconds maximum	<0.3 seconds to 1% of step
Input Resistance	10 MΩ, paralleled by <100 pF	2 MΩ ±1%, paralleled by <50 pF
Max. Input Voltage	350 VAC rms 500 V (DC + peak AC)	Front panel, V/Ω/Temp to LOW: 500 V rms or 600 VDC Front panel, V/Ω/Temp to GND and LOW to GND: 1000 V pk
CMRR	>60 dB (50/60 Hz)	≥60 dB @ 50/60 Hz (with 1 kΩ unbalance)
Max. Resolution	Same as Table 1 on this page	10 µV
Crest Factor	—	3:1 for 0.1% additional error
dB (True rms AC Volts)		
Accuracy	—	See Table 8 on page 386
Max. Resolution	—	0.01 dB
Response Time	—	<0.3 seconds to 1% of step
Input Resistance	—	2 MΩ ±1%, paralleled by <50 pF
Max. Input Voltage	—	V/Ω/TEMP to LOW: 500 V rms or 600 VDC V/Ω/TEMP to GND, LOW to GND: 1000 V pk
DC Current		
Ranges	200 µA, 2 mA, 20 mA, 200 mA, 2 A, 10 A	*200 µA, 2 mA, 20 mA, 200 mA, 2 A, 10 A
Accuracy	See Table 2 on this page	See Table 9 on page 386
Response Time	3 seconds maximum	<50 ms to 0.05% of step
Max. Open-Circuit Input Voltage	500 V (DC + AC peak)	650 V pk, mA to LOW
Max. Input Current	2 A fused, 10 A unfused	2 A any range, mA to LOW 10 A unfused, A to LOW
Max. Floating Voltage	N/A	10 A, mA or LOW to GND: 1000 V pk
Max. Resolution	0.1 µA	10 nA
Input Resistance	See Table 3 on this page	See Table 10 on page 386
AC Current		
Ranges	200 µA, 2 mA, 20 mA, 200 mA, 2 A, 10 A	*200 µA, 2 mA, 20 mA, 200 mA, 2 A, 10 A
Accuracy	±(1.5% of reading +4 counts) (18° to 28°C) 45 Hz to 500 Hz	See Table 11 on page 387
Response Time	8 seconds maximum	<0.3 seconds to 1% of step
Input Resistance	See Table 4 on this page	See Table 12 on page 387
Max. Open Circuit Input Voltage	650 V pk, A to COM	650 V pk, mA to LOW
Max. Input Current	2 A fused with 4 A high-energy fuse; 10 A unfused	2 A any range, mA to LOW; 10 A unfused, A to LOW
Crest Factor	—	3:1 for 0.1% additional error

Table 1 – DC Volts: Resolution

Range	Resolution
200 mV	±100 µV
2 V	±1 mV
20 V	±10 mV
200 V	±100 mV
500 V	±1 V

Table 2 – DC Current: Accuracy

Range	Accuracy
200 µA	±(1.0% of reading + 1 count)
2 mA	±(1.0% of reading + 1 count)
20 mA	±(1.0% of reading + 1 count)
200 mA	±(1.0% of reading + 1 count)
10 A	±(1.0% of reading + 3 counts)

Table 3 – DC Current: Input Resistance

Range	Resistance
200 µA	1.0 kΩ
2 mA	100 Ω
20 mA	10 Ω
200 mA	1 Ω
2000 mA	0.1 Ω
10 A	0.01 Ω

Table 4 – AC Current: Input Resistance

Range	Resistance
200 µA	1.0 kΩ
2 mA	100 Ω
20 mA	10 Ω
200 mA	1 Ω
2000 mA	0.1 Ω
10 A	0.01 Ω

Table 5 – Resistance: Accuracy

Range	Accuracy
200 Ω	±(0.75% of reading + 4 counts)
2 kΩ	±(0.75% of reading + 1 count)
20 kΩ	±(0.75% of reading + 1 count)
200 kΩ	±(0.75% of reading + 1 count)
2000 kΩ	±(0.75% of reading + 1 count)
20 MΩ	±(1.5% of reading + 5 counts)

Table 6 – DC Volts: Accuracy

Range	Accuracy: 18° to 28° C	Accuracy 0° to 18° C or 28° to 40° C
200 mV	±(0.03% + 0.015%)	±(0.1% + 0.04%)
2 V	±(0.03% + 0.01%)	±(0.08% + 0.02%)
20 V	±(0.03% + 0.015%)	±(0.1% + 0.025%)
200 V	±(0.03% + 0.01%)	±(0.08% + 0.02%)
1000 V	±(0.03% + 0.02%)	±(0.08% + 0.02%)
	±(% of reading + % of full scale) 41/2 digits, auto or manual ranging	

Continued on next page.

Digital Multimeters

STANDARD SPECIFICATIONS CONTINUED

	CDM250	DM2510/G
Resistance		
Ranges	200 Ω, 2 kΩ, 20 kΩ, 200 kΩ, 2 MΩ, 20 MΩ	*200 Ω, 2 kΩ, 20 kΩ, 200 kΩ, 2 MΩ, 20 MΩ
Accuracy	See Table 5 on page 385	See Table 13 on page 387
Response Time	5 s (200 Ω to 2000 kΩ ranges); 15 s (20 MΩ range)	< 0.2 s (200 Ω to 2 MΩ ranges); < 2 s (20 MΩ range)
Max. Input Voltage (accidental)	500 V (DC + peak AC)	300 V peak (all ranges)
Max. Resolution	0.1 Ω	10 mΩ
Max. Open Circuit Voltage	3.2 V max (200 Ω); 0.6 V max (2 kΩ to 20 MΩ)	< 11 V
Temperature Measurement	—	See Table 14 on page 387
Reading Rate	—	4.5 digits (normal) >3 times per second 3.5 digits (fast) >25 times per second
Warm-Up Time	10 minutes	30 minutes; 60 minutes after high humidity storage
Programmable	No	Yes
Computer Interface	—	GPIB (DM2510G only, on rear panel)
Safety	UL Listed, CSA Certified	ETL, CSA Certified
Environmental Requirements		
Ambient Temperature		
Operating	0°C to +50°C	0°C to +40°C
Nonoperating	–20°C to +60°C	–10°C to +60°C
Relative Humidity		
Operating	0% to 75%	0% to 75%
Nonoperating	0% to 80%	0% to 80%
Physical Characteristics		
Size (W x H x D)	240 mm x 64 mm x 190 mm 9.5 in. x 2.5 in. x 7.5 in.	240 mm x 105 mm x 198 mm 9.5 in. x 4.2 in. x 8.0 in.
Weight	1.6 kg (3.5 lb)	2.4 kg (5.2 lb)
Power Requirements		
Line Voltage	90 to 110 VAC, 108 to 132 VAC, 180 to 220 VAC, 216 to 250 VAC	90 to 110 VAC, 108 to 132 VAC, 198 to 242 VAC, 216 to 250 VAC
Line Frequency	50 to 60 Hz	50 to 60 Hz
Maximum Power Consumption	8 VA, 7 W	35 VA, 30 W

**Autoranging*

Table 7 AC Volts: Accuracy

Input Frequency	Accuracy 18° to 28° C	Accuracy 0° to 18° C or 28° to 40° C
20 Hz to 100 Hz	±(0.8% + 0.05%)	±(1.1% + 0.075%)
100 Hz to 10 kHz	±(0.3% + 0.05%)	±(0.6% + 0.075%)
10 kHz to 20 kHz	±(0.6% + 0.05%)	±(0.9% + 0.075%)
20 kHz to 50 kHz	±(1.0% + 0.05%)	±(1.3% + 0.075%)

±(% of reading + % of full scale)
41/2 digits, auto or manual ranging

Table 8 – dB Function: Accuracy

Range, dBV	Range, dBm	Accuracy 18° to 28° C	Accuracy 0° to 18° C or 28° to 40° C	Frequency
-34 to +54	-32 to +56	±0.3 dB	±0.4 dB	20 Hz to 20 kHz
-54 to -34	-52 to -32	±0.6 dB	±0.8 dB	20 kHz to 10 kHz
-60 to -54	-58 to -52	±1.0 dB	±1.5 dB	20 kHz to 10 kHz

41/2 digits, auto or manual ranging

Table 9 – DC Current: Accuracy

Range	Accuracy 18° to 28°C	Accuracy 0° to 18°C or 28° to 40°C
200 µA–2 A	±(0.06% + 0.01%)	±(0.2% + 0.025%)
10 A	±(0.3% + 0.05%)	±(0.6% + 0.075%)

±(% of reading + % of full scale)
41/2 digits, auto or manual ranging

Table 10 – DC Current: Input Resistance

Range	Resistance
200 µA	1.0 kΩ (mA to LOW)
2 mA	100 Ω (mA to LOW)
20 mA	10.2 Ω (mA to LOW)
200 mA	1.2 Ω (mA to LOW)
2 A	0.26 Ω (mA to LOW)
10 A	0.06 Ω (A to LOW)

Digital Multimeters

Table 11 – AC Current: Accuracy

Frequency (input > 200 counts)	Accuracy 18° to 28° C	Accuracy 0° to 18° C or 28° to 40° C
200 µA – 2 A Range:		
20 Hz to 100 Hz	±(0.8% + 0.05%)	±(1.1% + 0.075%)
100 Hz to 10 kHz	±(0.3% + 0.05%)	±(0.6% + 0.075%)
10 A Range:		
20 Hz to 10 kHz	±(0.8% + 0.05%)	±(1.1% + 0.075%)

±(% of reading + % of full scale)
41/2 digits, auto or manual ranging

Table 12 – AC Current: Input Resistance

Range	Resistance
200 µA	1.0 kΩ (mA to LOW)
2 mA	100 Ω (mA to LOW)
20 mA	10.2 Ω (mA to LOW)
200 mA	1.2 Ω (mA to LOW)
2 A	0.26 Ω (mA to LOW)
10 A	0.06 Ω (A to LOW)

Table 13 – Resistance: Accuracy

Range	Accuracy 18° to 28° C	Accuracy 0° to 18° C or 28° to 40° C	Source Current	Vmax
200 Ω	±(0.05% + 0.02%)	±(0.25% + 0.04%)	1.0 mA	10 V
2 kΩ	±(0.05% + 0.01%)	±(0.25% + 0.03%)	1.0 mA	10 V
20 kΩ	±(0.05% + 0.02%)	±(0.25% + 0.04%)	10 µA	10 V
200 kΩ	±(0.05% + 0.01%)	±(0.25% + 0.03%)	10 µA	10 V
2 MΩ	±(0.1% + 0.02%)	±(1.0% + 0.04%)	0.1 µA	2.0 V
20 MΩ	±(0.1% + 0.01%)	±(1.0% + 0.03%)	0.1 µA	2.0 V

±(% of reading + % of full scale)
41/2 digits, auto or manual ranging

Table 14 – Temperature: Accuracy

Range	Accuracy 18° to 28° C	Accuracy 0° to 18° C or 28° to 40° C	P6602 Probe Status
–62°C to +150°C	±0.6°C	±1.5°C	Calibrated
+150°C to +240°C	±1.6°C	±2.5°C	Calibrated
–62°C to +150°C	±3.5°C	±4.5°C	Uncalibrated
+150°C to +240°C	±6.0°C	±7.0°C	Uncalibrated

ORDERING INFORMATION

CDM250
Digital Multimeter ..... TD **$345**
Includes: DMM Test Leads (1 pair Black/Red) (196-3200-00), Operator's Manual (070-6736-00), US power cord (standard) and one year warranty.

DM2510
Digital Multimeter ..... TD **$595**
Includes: 1 pair DMM Test Leads (196-3200-01); Instruction Manual (070-8479-00), US power cord (standard) and one year warranty.

DM2510G
Programmable Digital Multimeter with GPIB Interface ..... TD **$695**
Includes: 1 pair DMM Test Leads (196-3200-01); Instruction Manual (070-8479-00), US power cord (standard) and one year warranty.

WARRANTY-PLUS SERVICE OPTIONS
Opt. M7 – Calibration Service
CDM250 ..... **+$43**
DM2510 ..... **+$125**
DM2510G ..... **+$140**

Opt. M9 – Repair Protection
CDM250 ..... **+$63**
DM2510 ..... **+$75**
DM2510G ..... **+$90**

INTERNATIONAL POWER PLUG OPTIONS
Standard – U.S. Power Cord: 120 V, 60 Hz ..... **NC**
Opt. A1 – Universal Euro: 220 V, 50 Hz (020-0859-00) ..... **NC**
Opt. A2 – United Kingdom: 240 V, 50 Hz (020-0861-00) ..... **NC**
Opt. A3 – Australian: 240 V, 50 Hz (020-0861-00) ..... **NC**
Opt. A4 – North American: 240 V, 60 Hz (020-0862-00) ..... **NC**
Opt. A5 – Switzerland: 220 V, 50 Hz (020-0863-00) ..... **NC**

OPTIONAL ACCESSORIES
Temperature Probe – Order P6602 ..... **$335**
GPIB Interface Cable – For DM2510G.
Order 012-0991-01 ..... TD **$170**
GPIB Reference Manual – For DM2510G.
Order 070-8630-00 ..... **$25**

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To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

CPS250
PS280
PS283

PS281
PS282

Power Supplies

Versatile bench or portable power supplies for most basic test and lab bench requirements.

CPS250

- Triple Output Power Supply
- Two Variable 0 to 20 V, 0.5 A Supplies
- Fixed 5 V, 2 A Supply
- Variable Current Limiting
- Overload Indicators
- UL Listed, CSA Certified

PS 280/283

- One Fixed 5 V, 3 A Supply
- Two variable Outputs, 0 to 30 V, 2A (PS250), 1A (PS283)
- Variable Current Limiting
- Selectable Independent Tracking Mode
- Dual Tracking, Variable 0 to 30 V, 2.0 A (PS280); 0 to 30 V, 1.0 A (PS283)

APPLICATIONS

- Education
- Depot Service
- Production Testing
- Laboratory

PS281/282

- 90W, Single Output, 3½ digit display.
- 0 to 30 V, 0 to 3A (PS281).
- 0 to 18 V, 0 to 5A (PS282).
- Variable current limiting.
- Overload and over voltage protection.

APPLICATIONS

- Education
- Depot maintenance
- Production testing

TD

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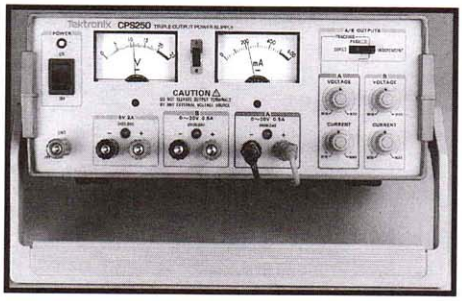


CPS250

The CPS250 Triple Output Power Supply is a versatile instrument with two variable and one fixed output. Its attractive, compact design with tilt-bail handle takes up less bench space than most other power supplies. It's designed to meet most basic test and lab bench requirements. Test leads are included.

PS280/PS283 Power Supplies

The Tektronix PS280 and PS283 Laboratory DC Power Supplies are multifunction bench or portable instruments. These regulated power supplies provide fixed 5 V output for powering logic circuits, and two variable outputs for a wide variety of test and experimental uses.

The PS280 and PS283 contain two identical, independently adjustable DC power supplies that can vary from 0 to 30 V and 0 to 2 A (1 A – PS283). Front panel switches select one of three modes of operation: independent, series, or parallel.

In the independent mode, the output voltage and current of each supply can be controlled independently. In the two tracking modes, the variable outputs are connected either in series or in parallel. Under these circumstances, the controls of the right (master) power supply adjust the voltages or current of both power supplies.

Power Supplies

CPS250
PS280
PS283

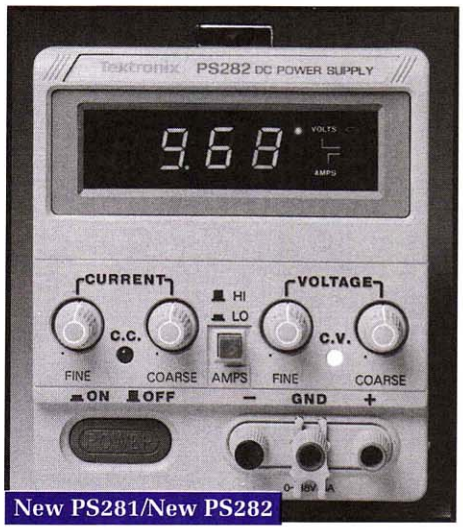
STANDARD SPECIFICATIONS

	PS280	PS283	CPS250
Output Voltage			
Two Variable	0–30 VDC	0–30 VDC	0–20 VDC
One Fixed	5.0 V	5.0 V	5.0 V
Output Current			
Two Variable	0–2.0 A (CC)	0–1.0 A (CC)	0 to 0.5 A (CC)
One Fixed	3.0 A maximum foldback current limited	3.0 A maximum foldback current limited	2.0 A maximum foldback current limited
Line Regulation			
Two Variable	0.01% + 3 mV (CV); 0.2% + 3 mA (CC)	0.01% + 5 mV (CV); 0.2% + 3 mA (CC)	0.01% + 3 mV (CV); 0.2% + 3 mA (CC)
One Fixed	≤5mV (CV)	≤5 mV (CV)	≤10 mV (CV)
Load Regulation			
Two Variable	≤0.01% + 5 mV, rating current >3 A (CV); ≤300 mV, 0–60 V single series tracking supply (CV); 0.2% + 3 mA (CC)	≤0.01% + 3 mV (CV) ≤300 mV, 0–60 V single series trackingsupply (CV); 0.2% + 3 mA (CC)	0.01% + 3 mV (CV); 0.2% + 6 mA (CC)
One Fixed	≤10 mV (CV)	≤10 mV (CV)	0.1% + 5 mV (CV)
Ripple / Noise			
Two Variable	≤1 mV rms, 5 Hz to 1 MHz (CV); ≤3 mA (CC)	≤1 mV rms, 5 Hz to 1 MHz (CV); ≤3 mA (CC)	2 mV rms, 5 Hz to 1 MHz (CV); 3 mA rms, 5 Hz to 1 MHz (CC)
One Fixed	2 mV rms	2 mV rms	2 mV rms
Output in Three Modes			
Independent Mode	Two variable 0–30 V (CV); 2.0 A (CC)	Two variable 0–30 V (CV); 1.0 A (CC)	Two variable 0–20 V (CV); 0.5 A (CC)
Parallel Mode	One 0–30 V, 4.0 A max	One 0–30 V, 2.0 A max	One 0–20 V, 1 A max
Tracking Error	±0.5% + 10 mV	±0.5% + 10 mV	±0.2% ±20 mV
Series Mode	One 0 ±30 V, 2.0 A max or one 60 V, 2 A	One 0 ±30 V, 1.0 A max or one 60 V, 1 A	One 0–40 V, 0.5 A or one ±20 V, 0.5 A
Tracking Error	±0.5% + 10 mV	±0.5% + 10 mV	±0.2% ±20 mV
Displays			
Readout	Two 3-1/2 digit LED (switchable)	Two 3-1/2 digit LED (switchable)	Two analog meters (switchable)
Voltage Indicator	0–30 VDC ± (0.5% of reading + 2 digits)	0–30 VDC ± (0.5% of reading + 2 digits)	0–25 VDC ±2.5% of full scale
Current Indicator	0–2 ADC ± (0.5% of reading + 2 digits)	0–2 ADC ± (0.5% of reading + 2 digits)	0–800 mA ±2.5% of full scale
Overload Indicator	Yes	Yes	Yes
Insulation			
Chassis to Terminal	≥20 MΩ at 500 VDC	≥20 MΩ at 500 VDC	>50 MΩ at 500 VDC
Chassis to Power Cord	≥30 MΩ at 500 VDC	≥30 MΩ at 500 VDC	>50 MΩ at 500 VDC
Safety	ETL	ETL	UL Listed, CSA Certified
Environmental Characteristics			
Temperature			
Operating	0°C to +40°C	0°C to +40°C	0°C to +50°C
Nonoperating	–10°C to +70°C	–10°C to +70°C	–20°C to +60°C
Humidity			
Operating	0% to 80%	0% to 80%	0% to 75%
Nonoperating	0% to 70%	0% to 70%	0% to 80%
Physical Characteristics			
Size (W x H x D)	225 mm x 145 mm x 335 mm 10 in. x 5.7 in. x 13.2 in.	225 mm x 145 mm x 335 mm 10 in. x 5.7 in. x 13.2 in.	240 mm x 100 mm x 213 mm 9.5 in. x 4.0 in. x 8.4 in.
Weight Net	11.5 kg (25.4 lb)	9.0 kg (22.1 lb)	4.8 kg (10.5 lb.)
Power Requirements			
Line Voltage	90 to 110 VAC, 108 to 136 VAC, 198 to 242 VAC, 216 to 250 VAC	90 to 110 VAC, 108 to 132 VAC, 198 to 242 VAC, 216 to 250 VAC	90 to 110 VAC, 108 to 132 VAC, 180 to 220 VAC, 216 to 250 VAC
Line Frequency	50 to 60 Hz	50 to 60 Hz	50 to 60 Hz
Maximum Power Consumption	348 VA, 250 W	254 VA, 172 W	175 VA, 160 W

(CV) When operated in constant voltage mode. (CC) When operated in constant current mode.

Power Supplies

PS281
PS282



New PS281/New PS282

PS281/282 DC Power Supplies

The Tektronix PS281/282 DC power supplies have been designed to meet the requirements in the laboratory, classroom and production environment. The output voltage is continuously adjustable between 0 to rating voltage, in one range, by means of coarse and fine potentiometer. Max 30 V for PS281 and max 18 V for PS282. The load current is also user adjustable from 0 to rating current by means of a coarse and fine potentiometer. Max 3A for PS281 and max 5A for PS282.

PS281's and PS282's are designed to be connected in series to increase voltage output or in parallel for a higher current output. Serial and parallel tracking can be achieved by connecting a jumper between two or more units at the rear panel.

The compact package and multiple operating modes of PS281/282 offer flexibility and convenience for a space limited engineering bench.

STANDARD SPECIFICATIONS

	PS281	PS282
Output Voltage		
One Variable	0–30 volts DC	0–18 volts DC
Output Current		
One Variable	0–3.0 amps	0–5.0 amps
Line Regulation		
One Variable	≤0.01% + 3 mV	≤0.01% + 3 mV
Load Regulation		
One Variable	≤0.01% + 3 mV	≤0.01% + 3 mV (≤3 amps) ≤0.01% + 5 mV (>3 amps)
Ripple / Noise		
One Variable	≤0.5 mV rms, 5 Hz to 1 MHz	≤0.5 mV rms, 5 Hz to 1 MHz (≤3 amps) ≤1.0 mV rms, 5 Hz to 1 MHz (>3 amps)
Tracking Mode		
Tracking Error	<±500 mV	<±500 mV
Displays		
Readout	One 3-1/2 digit LED	One 3-1/2 digit LED
Accuracy	±(0.5% of reading + 2 digits)	±(0.5% of reading + 2 digits)
Overload Indicator	Yes	Yes
Insulation		
Chassis to Terminal	≥20 MΩ at 500 volts DC	≥20 MΩ at 500 volts DC
Chassis to Power Cord	≥30 MΩ at 500 volts DC	≥30 MΩ at 500 volts DC
Safety	ETL	ETL
Environmental Characteristics		
Temperature		
Operating	0°C to +40°C	0°C to +40°C
Nonoperating	–10°C to +70°C	–10°C to +70°C
Relative Humidity		
Operating	0% to 80%	0% to 80%
Nonoperating	0% to 70%	0% to 70%
Physical Characteristics		
Size (WxHxD)	128 mm x 145 mm x 285 mm 5.0 in. x 5.7 in. x 11.2 in.	128 mm x 145 mm x 285 mm 5.0 in. x 5.7 in. x 11.2 in.
Weight (Net)	5 kg (11 lb)	4 kg (8.8 lb)
Power Requirements		
Line Voltage	90 to 110 VAC, 108 to 132 VAC, 198 to 242 VAC, 216 to 250 VAC	90 to 110 VAC, 108 to 132 VAC, 198 to 242 VAC, 216 to 250 VAC
Line Frequency		
Maximum Power Consumption	200 VA, 116 W	231 VA, 188 W

ORDERING INFORMATION

PS280
DC Power Supply ..... TD **$695**

PS283
DC Power Supply ..... TD **$625**
Both PS280/PS283 Include: Operator's Manual (070-8355-00); US power cord (standard); 3 pairs of Black/Red power supply output leads (196-3201-00) and one year warranty.

PS281
DC Power Supply ..... TD **$345**

PS282
DC Power Supply ..... TD **$345**
Both PS281/PS282 Include: Instruction Manual (070-88580-00);one pair of black/red test leads (196-3384-00); US power cord (standard) and one year warranty.

CPS250
Triple Output Power supply ..... TD **$445**
Includes: Operator's Manual (070-6740-00); Three Pair Test Leads (196-3201-00); US power cord (standard) and one year warranty.

WARRANTY-PLUS SERVICE OPTIONS

Opt. M7 – Calibration Service
PS280 ..... **+$45**
PS283 ..... **+$45**
PS281 ..... **+$60**
PS282 ..... **+$60**
CPS250 ..... **+$43**

Opt. M9 – Repair Protection
PS280 ..... **+$80**
PS283 ..... **+$80**
PS281 ..... **+$50**
PS282 ..... **+$50**
CPS250 ..... **+$81**

INTERNATIONAL POWER PLUG OPTIONS

Opt. A1 – Universal Euro, 220 V/60 Hz ..... **NC**
Opt. A2 – UK, 240 V/50 Hz ..... **NC**
Opt. A3 – Australia, 240 V/50 Hz ..... **NC**
Opt. A4 – North American, 240 V/60 Hz ..... **NC**
Opt. A5 – Switzerland, 220 V/50 Hz ..... **NC**

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- Automatic stimulus and measurements tools
- Modular instruments for custom systems
- A full line of accessories

From basic to advanced laboratory and bench instrumentation, our products will meet your needs in:

- Electronics
- Physics
- Mechanical Engineering
- Semi and fully automated test

And in every Tektronix product you'll find the familiar, easy operation that's become a de facto standard the world over. Which is perhaps the main reason why people in so many different environments prefer Tektronix equipment.

Because whether your students are preparing to seek their fortune, or applying what they've learned to make it, there's no substitute for the confidence that comes from using the best: Tektronix.

LEARNING MATERIALS

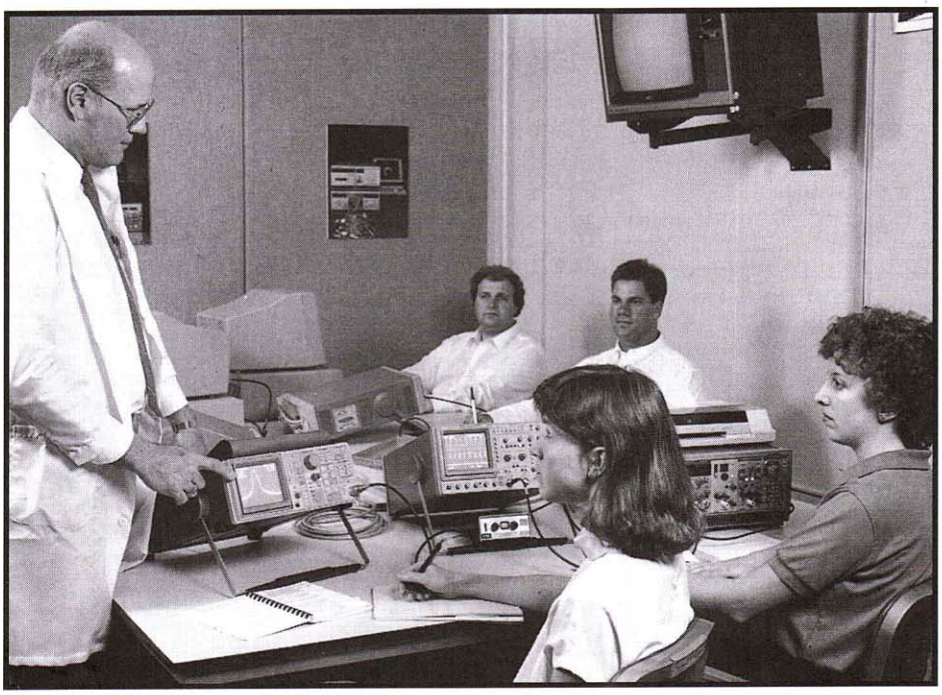
Tektronix learning materials are:

- Written by educators and instructional designers
- Professionally produced
- Comprehensive, covering both operations and concepts
- Designed for beginning through advanced students
- Available in videotapes, workbooks, instructors guides, quickstart, and self-study packages

Tektronix has a long history of commitment to partnership with education. To further assist you in reaching your educational goals, Tektronix now offers qualifying institutions the finest test and measurement equipment at substantial discounts.

We are giving eligible non-profit organizations discounts of 15% on all of Tektronix test and measurement equipment, and 50% on Tektronix developed software.

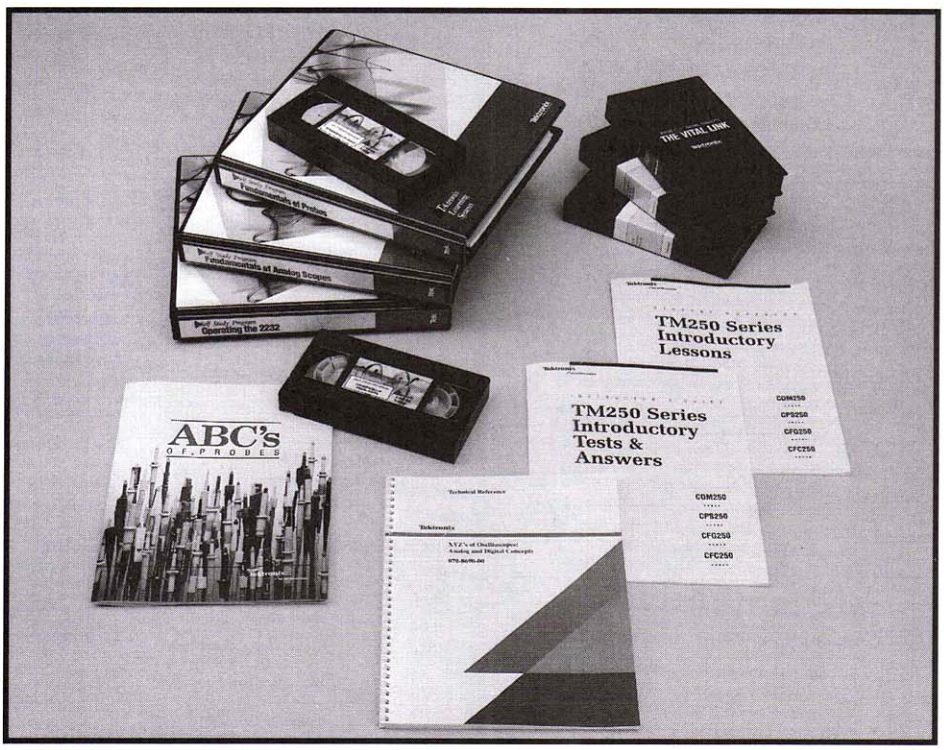
To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.



Tektronix offers the total solution for your classroom with a broad range of test and measurement instrumentation. From spectrum analyzers and oscilloscopes to modular instruments and printers.

'A diverse environment demands an extensive selection'

Test and Measurement
Education



Tektronix' extensive selection of learning materials can save you countless hours in the preparation and presentation process so that you can concentrate on what you do best – educating our next generation of engineers and technicians.

Courseware and Training

For many instructors, the time spent preparing to teach far outweighs the time spent teaching. That's why we offer comprehensive and self-contained courseware. This courseware is designed to complement and supplement the broad range of Tektronix test and measurement products and your classroom curriculum.

SELF-STUDY PACKAGES

Realizing the need for individuals to learn at their own pace, Tektronix has developed an extensive line of self-study packages. The engineer as well as the student can sharpen their skills in instrument usage and application in less time than learning by trial and error.

In less than an hour, the student can learn the unique time-saving features of the equipment, and put these to use immediately. The result is increased productivity.

To conserve valuable lab time, Tektronix has created these aids so that students can come prepared to apply their understanding of the equipment to the challenges of the curriculum.

Each self-study course includes a detailed video instruction tape and a workbook. Materials cover instrument operations as well as concepts and applications, from basic through advanced test and measurement techniques. Discussions include:

- Basic Instrument Concepts
- Major Product Features and Operation
- Applications
- Probe Compensation and Usage
- Measurement Techniques
- Controller Integration
- Communication Interfaces
- Display and Output Concepts

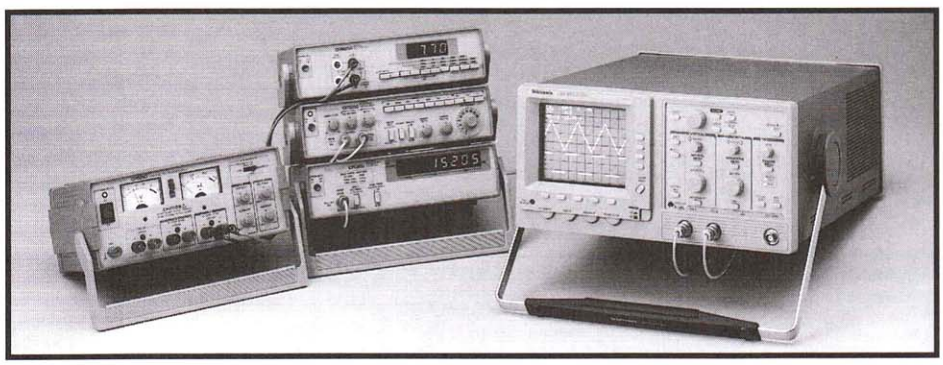
QUICKSTART PACKAGES

These especially designed packages provide detailed hands-on instruction and application examples. Each package provides step-by-step workbooks and especially designed signal generation boards to help the user get up and running in no time at all. These packages are designed for self-paced use or integrated into the classroom curriculum.

VIDEO TAPE AND LITERATURE

Tektronix offers educators one of the most extensive libraries of video taped presentations on theory and application in the industry. And for classroom and lab work, Tektronix' primers and workbooks take students from the most basic level of skills through the highest levels of sophistication they'll need for a successful career.

Test and Measurement
Education



Lab bench stations can be configured to your needs. Our stackable triple-output power supply, digital multimeter, 100 MHz frequency counter and 2 MHz function generator (see pages 370-390) join a 100 MHz dual-trace TAS 465 Oscilloscope (pages 114-117) as a popular setup for basic lab stations.

Tektronix cameras and printers make lab documentation easy. Tektronix SCOPE-MOBILE® carts free up valuable bench space and make sharing of equipment between students convenient.

RUGGED AND SAFE
In both design and test, we ensure our products meet stringent standards for EMI, humidity, temperature, electro-static shock, and vibration. Tektronix products are also third-party certified by UL, CSA and VDE. Not only do these certifications protect you and your students, they help you comply with many state and local regulations.

SERVICE AND SUPPORT ALSO KEY
Tektronix' highly trained sales engineers, applications engineers, and education representatives stand ready to offer you both curriculum and technical support. Our curriculum support materials and workshops will help you keep up-to-date. Also, we offer standard warranties as well as a variety of extended warranty packages to keep your Tektronix equipment calibrated and in the best working condition.

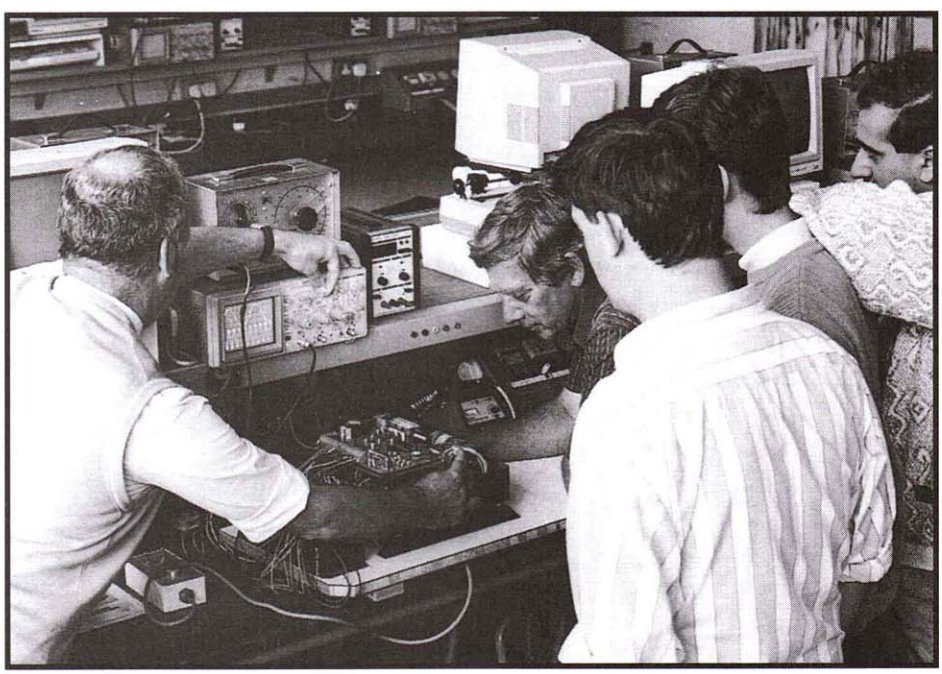
To complement the warranty programs, Tektronix has service centers conveniently located around the U.S. and throughout the world. However, the chances are good that you'll never have to take advantage of our service network, because all Tektronix equipment is built to the highest standards of mechanical and environmental durability.

BUDGET SOLUTIONS
At Tektronix we understand the dilemma that many educators face – you have a need for industry proven, up-to-date equipment, but your budgets don't always allow for funding.

Therefore, we offer a line of low-cost basic electronics equipment that meets the needs of both education and industry. You'll also be pleased to know that Tektronix offers special pricing for educational institutions.

We are working to meet your educational objectives – providing technologically advanced products, budget alternatives, and superior quality and service.

'It's easy to justify owning the best when the best costs less.'



Peter Jackson, the Head of the Electronics Department at Hatfield Poly., Hertfordshire, England, purchased Tektronix' 2225 scopes for use by their students. John Aitken, the Head of Division, states "The 2225 fulfilled our technical requirements, and ... offers good value for the money."

Test and Measurement
Education

ORDERING INFORMATION

VIDEO TAPE SELECTION GUIDE
Note: "XX" is to be replaced by one of the following:
NTSC format (used in USA)
00 = 3/4 in., **01** = BETA I, **02** = BETA II,
03 = BETA III, **04** = VHS/NTSC
PAL format
06 = VHS/PAL, **08** = Workbooks
SECAM format
07 = VHS/SECAM

SELF-STUDY PACKAGES
Each self-study course includes a detailed video instruction tape and a workbook. Additional workbooks are available at 4/$100.

Fundamentals of Analog Scopes 068-0270-XX **$115**
Fundamentals of Probes 068-0269-XX **$115**
Fundamentals of Digital Scopes 068-0268-XX **$115**
Fundamentals of GPIB 068-0260-XX **$115**
Fundamentals of RS232 068-0259-XX **$115**
Using the PC as a Controller 068-0301-XX **$145**
Fundamentals of Logic Analyzers068-0291-XX **$115**
Operating the 2201 068-0290-XX **$60**
Operating the 2205 068-0289-XX **$60**
Operating the 2210 068-0274-XX **$125**
Operating the 2211 068-0311-XX **$125**
Operating the 2213A/2215A 068-0278-XX **$115**
Operating the 2220 068-0273-XX **$125**
Operating the 2221 068-0272-XX **$115**
Operating the 2224 068-0310-XX **$125**
Operating the 2225 068-0279-XX **$115**
Operating the 2230 068-0271-XX **$125**
Operating the 2232 068-0312-XX **$125**
Operating the 2235 068-0277-XX **$115**
Operating the 2236 068-0276-XX **$115**
Operating the 2245/2246A 068-0275-XX **$115**
Operating the 2245A 068-0325-XX **$125**
Operating the 2246A 068-0326-XX **$125**
Operating the 2247A 068-0327-XX **$125**
Operating the 2430A 068-0267-XX **$145**
Operating the 2432 068-0266-XX **$145**
Operating the 2432A 068-0305-XX **$145**
Operating the 2440 068-0265-XX **$145**
Operating the 2445A/2465A 068-0262-XX **$145**
Operating the 2445B/2465B/2467B 068-0261-XX **$145**
Operating the 11301A/11302A 068-0264-XX **$145**
11301/11302 Waveform Measurement 068-0304-XX **$145**
11401/11402 Waveform Measurement 068-0302-XX **$145**
11401/11402 Adv. Waveform Measurement 068-0303-XX **$145**
Operating the 1230 068-0288-XX **$115**

QUICKSTART PACKAGES
Each package is designed to give step-by-step instruction using workbooks and specially designed signal generation boards.

2400 Series Digital Oscilloscopes QuickStart Package*1
020-1679-00 U.S. power (VHS/NTSC), 020-1681-00 European power (VHS/PAL) **$220**

2402 TekMate QuickStart Pkg
020-1747-00 (U.S.), 020-1748-00 (European) **$270**

11403 QuickStart Package
020-1767-01 (U.S.), 020-1768-01 (European) **$220**

DSA 600 QuickStart Package
020-1769-00 (U.S.), 020-1770-00 (European) **$220**

2252/2247A/2245A QuickStart Package*1
020-1864-04 (VHS/NTSC), 020-1864-06 (VHS/PAL) **$199**

2232/2224/2221A QuickStart Package*1
020-1812-04 (VHS/NTSC), 020-1812-06 (VHS/PAL) **$199**

VIDEO TAPES

Oscillo-what? What is an Oscilloscope? Discusses the display, vertical, horizontal and trigger sections and introduces digitizing oscilloscopes. 068-0218-XX **$60**

Oscilloscope Primer Practical Scope How to use a scope, acquire a trace, select suitable vertical and horizontal scale factors, and how to use the special features on the Tektronix 2225 oscilloscope. 068-0227-XX **$60**

Advanced 2200 Series Operation 068-0151-XX **$60**
CDM250 Video Tape Digital multimeter training 068-0254-XX **$60**
CFC250 Video Tape Frequency counter training 068-0253-XX **$60**
CFG250 Video Tape Function generator training 068-0252-XX **$60**
CPS250 Video Tape Power supply training 068-0251-XX **$60**
The Vital Link – Probe and Signal Concepts 068-0229-XX **$75**

Fundamentals of Oscilloscopes: A Functional Overview
For people with prior electronics knowledge and some exposure to oscilloscopes. Explains functional characteristics of a typical analog oscilloscope. 068-0217-XX **$60**

Fundamentals of Oscilloscopes: Digital Storage Concepts
Describes and illustrates functional concepts of typical digital storage oscilloscope. 068-0240-XX. **$60**

22PS PowerScout Operation Overview of oscilloscope operation and a detailed front panel tour of the 222PS PowerScout. 068-0344-XX. **$60**

Understanding Spectrum Analyzers Highlights differences between time and frequency domain displays. Examines real time and swept super heterodyne spectrum analyzers. Demonstrates basic controls and functions. 068-0350-XX. **$60**

LITERATURE

Lab Bench Equipment Orientation Instructor guide and workbooks for CFC250, CFG250, CDM250 and CPS250. (50 workbooks, 1 guide) 062-9511-01 ..... **$50**

Oscilloscope XYZs Primer Covers horizontal, vertical and trigger functions, controls, use of probes, terminology, and theory of waveforms and measurement techniques (50 primers) 062-9323-01 ..... **$120**

ABCs of Probes 062-9471-00 (50 primers) **$120**

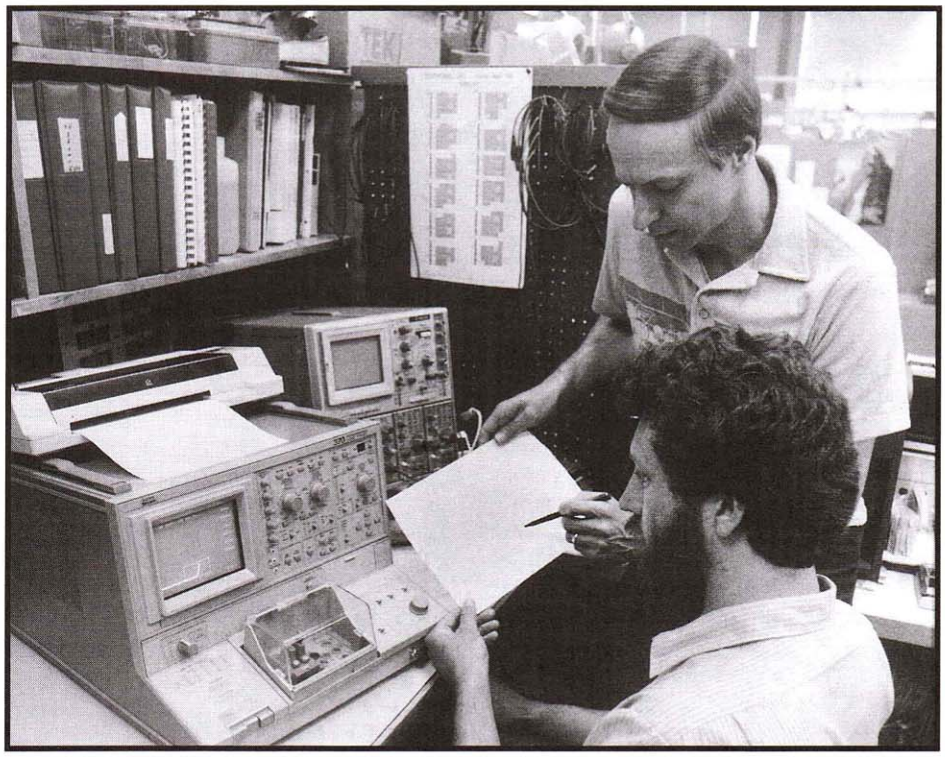
**1 Video-tape included where noted.*

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

Semiconductor DC Characterization

Characterization and Test Solutions for Semiconductors Design, Manufacture and Quality Assurance

- The 372 Semiconductor Workbench features 25 fA, 25 uV resolution for precise low current measurements.
- The 370A, provides a broad measurement range with up to 20 A capability.
- The 3000 W 371A has all the power you will need for high power semiconductors.



CONTENTS

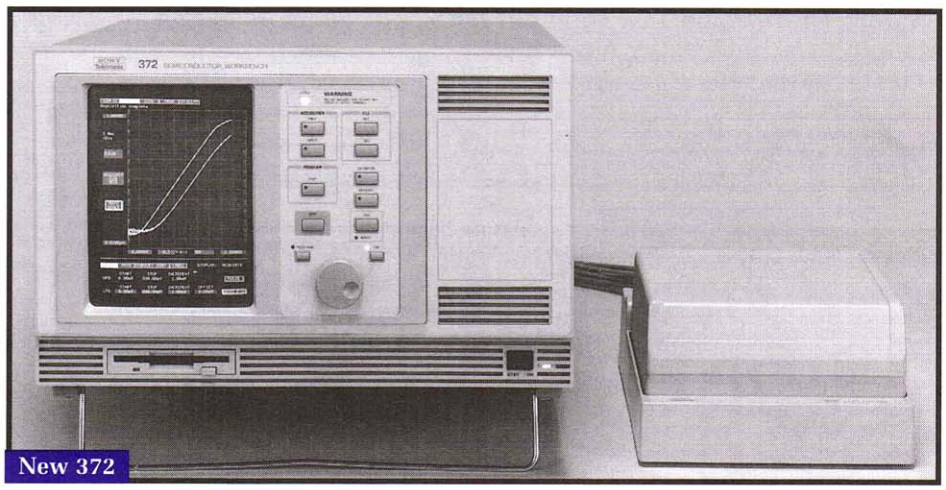
372 Semiconductor Workbench 396
370A Curve Tracer 398
371A High Power Curve Tracer.....400
577D1 Storage Curve Tracer.....401
177 Standard Test Fixture.....401
571 Curve Tracer 402
Device Adapters.....403

Semiconductor Workbench

Advanced features provide fast access to even the most complex measurements.

372

- Range: up to 200 V, 400 mA
- Resolution: to 25 fA, 25 µV
- Kelvin sense
- Flexible waveform math
- Automatic pass/fail testing
- MS-DOS compatible disk
- Stand-alone programming
- Hardcopy output



New 372

NEW! 372 Semiconductor Workbench

Now there's a new approach to semiconductor characterization – the new 372 Semiconductor Workbench combines the resolution and advanced features typically found in parameter analyzers with a curve tracer's interactive user interface and sourcing capability. Plus, it provides new features, such as automatic pass/fail testing and built-in setups, that greatly reduce the cost and time needed for DC characterization.

The 372 provides the measurement capabilities and advanced analysis required for IC research, design, manufacturing and quality assurance testing. With two high-precision stimulus-response units you can make highly accurate, Kelvin sense, current measurements with 25 fA resolution and source up to 400 mA or 200 V with a maximum output of 10 watts. Powerful analysis features such as waveform math and flexible display parameters allow you to see your results in the form you want. These capabilities make the 372 useful for a wide range of device technologies including CMOS, bipolar, GaAs and BiCMOS.

HIGH PRECISION STIMULUS/RESPONSE

The keys to the 372's performance are its high precision stimulus-response units – a low power unit capable of sourcing a maximum 100 mA and 100 V, and a high power unit capable of sourcing 400 mA and 200 V. Both units have Kelvin sense capability. These two units and an active ground unit capable of sinking up to 700 mA at 0 V ±1 mV can be flexibly interchanged among device terminals via an internal switching matrix.

POWERFUL ANALYSIS

In addition to a high precision stimulus-response system, the 372 has powerful tools for device analysis. The 372's waveform math function lets you display a mathematical function of the data on the y-axis. So whether you want to display log I_C and log I_B versus V_{BE} or the square root of I_D versus V_{GS}, the 372 lets you see what you want to see. The 372 also lets you plot current or voltage versus time for tracking down critical device drift problems. And, the 372 has 4 different cursor types which allow you to measure I, V points, slopes, gain, or make automatic pass/fail decisions.

INTERACTIVE CONTROL

The 372's interactive interface allows you to configure a test and view the data on the same menu screen, giving you instant feedback. In many cases you can change set up parameters by simply touching the parameter on screen and turning the general purpose knob – no paging through menus. This level of interaction lets you get to the bottom of tough problems quickly.

APPLICATIONS

QA/Incoming Inspection: Whether you need a fully automated solution, a manual solution, or something in between, the 372 is ideal for QA and incoming inspection applications. The 372's program mode will let you fully automate many test sequences, eliminating the need for an external controller. Pass/no-pass cursors make pass/fail decisions on your acquired data, saving time and eliminating the need for external data analysis. The 372 is also programmable over GPIB and for those who want to step through each test manually, setups may be recalled from MS-DOS formatted diskettes to speed the configuration process.

Process Monitoring: With its highly accurate stimulus/response units and its automation features, the 372 is an excellent tool for process monitoring. Whether your technology is bipolar or MOS the 372 has the ranges and resolutions necessary for typical wafer level measurements. For stand-alone monitoring applications measurements may be automated under the 372's program mode, or by recalling setups from disk.

Device Research/Troubleshooting: An interactive user interface for zeroing in quickly on device characteristics, highly accurate measurements of up to 4000 points, and a flexible display to see the data in a useful form are all powerful tools for device research and troubleshooting applications.

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

Semiconductor Workbench

Source Characteristics

The 372's two stimulus/response units, the high power unit (HPU) and the low power unit (LPU), both have the same resolution and accuracy. The HPU simply extends the maximum ranges of the LPU from 100 mA and 100 V to 400 mA and 200 V. Range resolution and accuracy for the HPU is specified as follows:

HPU VOLTAGE RANGE, RESOLUTION AND ACCURACY

V Range	Resolution	Stimulus Accuracy	Response Accuracy	Max Current
0.1 V	25 µV	±(0.1% + 500 µV)	±(0.1% + 500 µV)	400 mA
1 V	250 µV	±(0.1% + 500 µV)	±(0.1% + 500 µV)	400 mA
10 V	2.5 mV	±(0.1% + 5 mV)	±(0.1% + 5 mV)	400 mA
100 V	25 mV	±(0.1% + 50 mV)	±(0.1% + 50 mV)	100 mA (V > 10 V) 400 mA (V ≤ 10 V)
200 V	50 mV	±(0.1% + 100 mV)	±(0.1% + 100 mV)	40 mA (V > 100 V) 100 mA (10 V ≤ V < 100 V) 400 mA (V ≤ 10 V)

HPU CURRENT RANGE, RESOLUTION, AND ACCURACY

Range	Resolution	Stimulus Accuracy	Response Accuracy	Max V
100 pA	25 fA	±0.6% ± 6 pA + 100 fAxV_o*	±0.6% ± 5 pA + 100 fAxV	200 V
1 nA	250 fA	±0.6% ± 7 pA + 100 fAxV_o	±0.6% ± 6 pA + 100 fAxV	200 V
10 nA	2.5 pA	±0.5% ± 23 pA + 100 fAxV_o	±0.5% ± 20 pA + 100 fAxV	200 V
100 nA	25 pA	±0.5% ± 180 pA + 100 fAxV_o	±0.5% ± 150 pA + 100 fAxV	200 V
1 µA	250 pA	±0.1% ± 1.8 nA + 100 fAxV_o	±0.1% ± 1.5 nA + 100 fAxV	200 V
10 µA	2.5 nA	±0.1% ± 18 nA	±0.1% ± 15 nA	200 V
100 µA	25 nA	±0.1% ± 180 nA	±0.1% ± 150 nA	200 V
1 mA	250 nA	±0.1% ± 1.8 µA	±0.1% ± 1.5 µA	200 V
10 mA	2.5 µA	±0.1% ± 18 µA	±0.1% ± 15 µA	200 V
100 mA	25 µA	±0.1% ± 180 µA	±0.1% ± 150 µA	100 V (I > 40 mA) 200 V (I ≤ 40 mA)
400 mA	100 µA	±0.1% ± 720 µA	±0.1% ± 600 µA	10 V (I > 100 mA) 100 V (100 mA ≥ I > 40 mA) 200 V (I ≤ 40 mA)

V_o = (HPU voltage ÷ 1 V)

Source and measurement accuracies are specified at 23°C ±5°C after instrument has been allowed to warm up for at least 40 minutes with AUTOCAL set to ON.

ORDERING INFORMATION

372
Semiconductor Workbench **$24,950**
Includes: Operator's Manual; 3.5 in., 2HD Floppy Disk; Power Cord; Fast Blow 250 V, 1 A Fuse; Test Fixture and Cable; six 1.5 meter Triaxial Cables; Set of Miniature Banana Connection Leads; Carrying Case; A1101, A1102, A1103 and A1104 Adapters.

Opt. 1R – Rackmount ..... **+$495**
Opt. 20 – 3 meter cable set ..... **+$2,900**

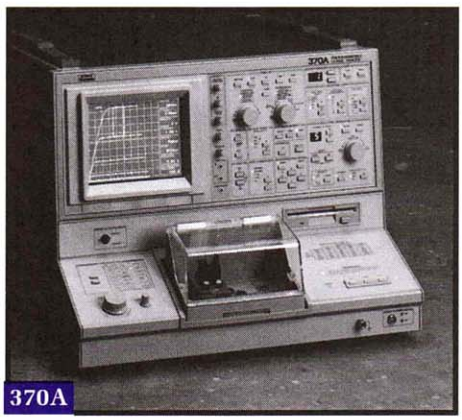
To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

Curve Tracer

Wide measurement range and productivity enhancement features allow the 370A to address a broad range of semiconductor devices.

370A

- Automatic Test Sequences
- 3.5 inch MS-DOS Compatible Disk Storage
- Non-Volatile Storage via GPIB Interface
- Waveform Comparison
- Dot Cursor
- Envelope Display
- Digital Storage Display and Non-Storage Mode
- Waveform Averaging



370A Programmable Curve Tracer

The 370A Programmable Curve Tracer provides DC parameter characterization of transistors, thyristors, diodes, SCRs, MOSFETs, optoelectronic components, solar cells, solid state displays and other semiconductor devices. With the 370A you can perform automated device characterizations for: manufacturing processes, incoming inspection, semiconductor R & D, quality control, component engineering, component matching and failure analysis.

INTERACTIVE, PROGRAMMABLE CONTROL

Interactive control of all measurements allows you to refine characterizations for unique devices during research or design. After completing the characterization definition, interactive settings can be stored in the curve tracer's memory, disk or an external controller.

The 370A's non-volatile memory provides automatic test sequencing. Or, you may perform external controller test sequencing from an IBM compatible PC via the GPIB interface. With either method, the 370A front panel settings can be recalled and measurements made, storing the results for later review or comparison.

TEST FIXTURING

The test fixture is a standard accessory that provides safe device enclosure to assure operator protection during measurements. The test fixture accommodates standard A1001 through A1005 adapters with Kelvin sensing, 3-pin adapters without Kelvin sensing and the A1023 and A1024 surface mount adapters.

SOFTWARE

For automated custom device characterization the 370A Utility Software with an IBM PC provides customized tests, consistent measurements and logging of results. And with the 370A Device Test Software you can automatically characterize most semiconductor components.

HARDCOPY

Plotter output data is sent directly from the 370A without the need for an external controller. Plotting can continue while the 370A performs the next tasks.

ACQUISITION

In storage mode, information is displayed in one of three ways: normal, envelope or average.

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

Curve Tracer

Source Characteristics

COLLECTOR SUPPLY

Modes – AC, ±DC, ±Leakage, ±Rectified Sine.

Range	Max Peak Current (±)	Peak Current Pulsed (±)*
16 V	10 A	20 A
80 V	2 A	4 A
400 V	.4 A	.8 A
2000 V	.05 A	.1 A

**Collector supply is not pulsed; assumes a pulsed step generator supply.*

STEP GENERATOR

Modes – Stair step: DC, 80 µsec pulse, 300 µsec pulse.

Step Range – Current: 50 nA to 200 mA in 1-2-5 sequence. Voltage: 50 mV to 2 V in 1-2-5 sequence.

Offset – Up to ±10X step amplitude.

No. of steps – 0 to 10.

Measurement Characteristics

Collector Current – Measurement range: 100 nA/div (1 nA resolution) to 2 A/div. Accuracy: 1.5% of cursor readout +0.05 div of setting (with dot cursor).

Emitter Current – Measurement range: 1 nA/div (10 pA resolution) to 2 mA/div. Accuracy: 1.5% of cursor readout + 0.05 div of setting + 1 nA.

370A DEVICE TEST SOFTWARE

The pop-up windows prompt selection of the following devices and tests:

NPN and PNP Transistors – V(br)ceo, V(br)ebo, V(br)cbo, Vce(sat), Vebo (sat), Icev, hFE.

N and P MOSFET – BVdss, Idss, Vgs(th), Id(on), Rds(on), gm, Igss.

N and P JFET – Idss, V(br)gss, Igss, gm, Vgs(off).

SCR – Vdrm, Idrm, Irrm, Igt, Vgt, Vtm, Ih.

Diode – Vf, PIV, Ir.

Zener – Vz, Vf.

Resistor – Ohms.

These common DC measurements are typically performed at least four times faster than manual methods.

UTILITY SOFTWARE

With a library of user defined custom measurements stored in an IBM PC or compatible, you can characterize any device with unique or uncommon measurement sequences. The utility menu provides easy access to functions that simplify curve tracer operations.

ORDERING INFORMATION

370A

Curve Tracer **$21,900**

Includes: Blank Adapter A1001; In-line Transistor A1002, Axial Diode Lead Adapter A1005; 4 and 6 Lead Transistor/FET Adapter A1007; Floppy Diskette (119-3446-00); Protective Cover (337-3344- 00); Spare Fuses 125V/4A (159-0259-00); Slow Blow 250V/2A Fuse (159-0160-00); Power Cord (161-0066- 00); Operator's Manual (070-7779-00).

Opt. 1P – HC100 Plotter with Opt. 01 ..... **+$1,180**

Opt. 1R – Rack Mounting ..... **+$495**

Opt. 26 – 370A Utility SW ..... **+$525**

Opt. 27 – 370A Device Test SW ..... **+$2,050**

ADDITIONAL ACCESSORIES

Service Manual – Order 070-7780-00 ..... **$135**

Calibration Fixture – Order 067-0187-00 ..... **$645**

Rackmount Kit – Order 016-0930-00 ..... **$1,045**

Socket Adapters – See adapters on page 403.

SOFTWARE

S48P104 – 370A Utility Software on 3.5 in. disk **$525**

Opt. 01 – 5.25 in. disk ..... **NC**

S48P401 – 370A Device Test Software on 3.5 in. disk **$2,050**

Opt. 01 – 5.25 in. disk ..... **NC**

CART – Order K217S **$780**

CAMERA – Order C-9 Opt. 1A and Opt. 07 ..... ***1**

**1 Contact your local Tektronix representative for price information.*

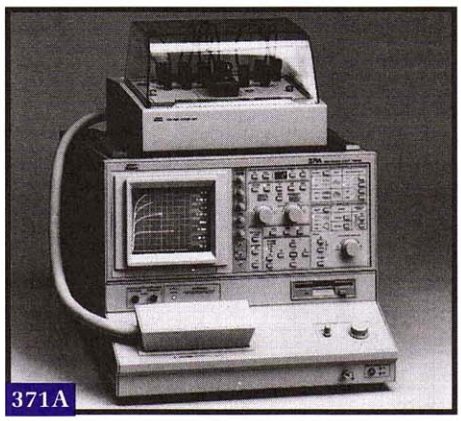
To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

Curve Tracer

For characterization and test of power semiconductors.

371A

- Test High Power Devices:
  - Up to 3,000 Volts
  - Up to 400 Amps
  - Up to 3,000 Watts
- Automatic Test Sequences
- 3.5 inch MS-DOS Compatible Disk Storage
- Waveform Comparison
- Cursor Measurements
- Readout of Control Settings and Cursor Values



371A High Power Curve Tracer

The 371A High Power Curve Tracer is specifically designed to provide automated DC parameter characterization of high power semiconductor devices such as thyristors, STRs, IGBTs, and power MOSFETs. The high voltage collector mode permits testing the Off-Characteristics of a device up to 3000 Volts. The pulsed high current collector mode provides output current pulses greater than 400 amps peak for testing On-Characteristics. It also permits high power testing up to 3,000 watts.

COMPLETE PROGRAMMABILITY

The 371A provides remote setup, computerized control and software analysis with external programming over the IEEE-488 GPIB.

COMPREHENSIVE STORAGE CAPABILITIES

For enhanced productivity the 371A can save up to 64 setups and 64 displays on a 3.5 inch floppy and 16 of each in internal memory. With stored setups you can easily cycle through a series of tests, either manually or automatically through GPIB program control. To help identify data, up to 24 characters of text may be used to label or annotate a curve.

AUTOMATED CURSOR MEASUREMENTS

The 371A provides three cursor measurement modes. The Dot cursor provides direct screen readout of voltage, current, gm or DC beta at any point. The Window cursor can be positioned between two curves to measure small signal beta or gm, and can also be used for visual go/no-go tests. The Function Line cursor provides screen readout of a slope or intercept value.

SWEEP MEASUREMENT MODE

In the Sweep Measurement Mode the 371A will automatically construct a family of curves while stimulating the device with low duty-cycle pulses. With this capability, power curves can be displayed without excessive heating of the device.

Characteristics

COLLECTOR SUPPLY

Modes – High Current: 250 µsec pulses with max. peak of 30 volts. High Voltage: Full rectified sine with max. peak of 300 volts (positive and negative polarities for both modes).

Range	Peak Current	Peak Power
30 V	400 A	3 kW
30 V	40 A	300 W
300 V	40 mA ±20%	30 W
300 V	4 mA ±20%	3 W
3 kW	4 mA 0 ±20%	300 mW
3 kW	4 mA ±20%	30 mW

Measurement Characteristics

COLLECTOR CURRENT

Maximum Power Setting	Vertical Range (in 1-2-5 increments)
3 kW	1 A/div to 50 A/div
300 W	500 mA/div to 5 A/div
30 W	100 µA/div to 5 mA/div
3 W, 300 mW	10 µA/div to 500 µA/div
30 mW	1 µA/div to 50 µA/div

Accuracy: within 0.1 vertical division.

317A TEST FIXTURE

Designed to allow easy connection to a variety of devices. It has a safety enclosure to assure operator protection. Special patch cords are provided for connecting large devices.

STEP GENERATOR

Modes – Current (stair step): DC, 500 µsec ±10% of pulse.Voltage (stair step): DC.

Step Range – Current: 1 mA/step to 2 A/step pulsed (hi current mode). 1 µA/step to 2 mA/step DC (hi voltage mode).
Voltage: 200 mV/step to 2 mA/step.
Offset: ±10X step amplitude (5X in 5 V/step and 2 V/step settings).

ORDERING INFORMATION

371A
High Power Curve Tracer **$25,900**
Includes: In-line Transistor A1002; TO3/TO66 Adapter A1003; Power Cord (070-6839-00); Operator's Manual (070-8043-00); and Pocket Reference Guide (070-6841-00).
Opt. 1P – HC100 Plotter ..... **+$995**
Opt. 26 – 371A Utility SW ..... **+525**

ADDITIONAL ACCESSORIES
Field Wiring Cable – Order 198-5628-00 ..... **$365**
Service Manual – Order 070-6840-00 ..... **$105**
Calibration Fixture – Order 067-1345-00 ..... **$3,995**
Rackmount Kit – Order 016-0930-00 ..... **$1,045**
Socket Adapters – See Adapters Section on page 403.

SOFTWARE
S48P104 – 371A Utility Software on 3.5 in. disk **$525**
Opt. 01 – 5.25 in. disk ..... **NC**
CART – Order K217S **$780**

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

Curve Tracer

577D1

The 577D1 Curve Tracer with the Tektronix 177 plug-in adapter allows DC parameter characterization of transistors, thyristors, diodes, SCRs, MOSFETs, optoelectronic components, solar cells, solid state displays and other semiconductor devices. Typical measurements include leakage, breakdown voltages up to 1600 volts, MOSFET Vgs(th) SCR Vgt/Igt, Diode Vf, ZENER Vz/Vf, resistance as well as other DC parameters.

Interactive Control

The 577D1 provides the same industry standard and familiar interactive manual controls available on the Tektronix 370A and 371A Curve Tracers. With interactive controls, the curve tracer can provide refined characterizations on standard and unique device for component engineering, research, or design.

DISPLAY
The 165 mm (6.5 inch) rectangular display provides an 8 x 10-cm display with parallax-free, internal graticule. It also has a split screen storage display useful for comparing two devices.

Characteristics

Voltage Range	6.5 V	25 V	100 V	400 V	1600 V
Max Continuous Current Range	10 A	2.5 A	0.6 A	0.15 A	0.04 A
Peak Current Pulsed	20 A	5 A	1.25 A	0.3 A	0.08 A
Min. Series Resistance (Ω)	0.12	1.9	30	500	8 k
Max. Series Resistance (Ω)	8 k	120 k	2 M	8 M	8 M

COLLECTOR CURRENT
Measurement range is .2 nA/div to 2 A/div.

COLLECTOR/BASE VOLTAGE
Measurement range is 5 mV/div to 200 V/div for the collector and 5 mV/div to 2 V/div for base voltage.

STEP GENERATOR
The step generator has 0 to 95 steps, 5 nA to 200 mA in the current mode and 5 mV to 2 V in the voltage mode. Offset control is variable from –10 to +10X step amplitude. In pulsed mode, the step generator changes from stair step output to 300 μsec wide pulses.

Test Fixturing

The 577D1 requires the Tektronix 177 test fixture. With the 177 plug-in, the 577D1 is a standard curve tracer system that can make traditional DC parametric measurement. Socket adapters for different device package styles, including adapters with Kelvin sensing, are described in the socket adapter section.

577D1
- Measures DC parameters of 2 and 3 Terminal Devices
- Display Storage
- Up to 100 Watts
- Lowest Price Curve Tracer System

APPLICATIONS:
- Semiconductor R&D
- Production Device Testing
- Incoming Inspection
- Component Engineering Characterization

Lowest priced curve tracer with full measurement range.

ORDERING INFORMATION

577D1
Storage Curve Tracer **$10,050**
Requires 177 plug-in adapter.

177
Standard Test Fixture **$2,095**
Includes: A1005 Axial Diode Lead Adapter; A1007 Transistor Adapter; Safety Cover (337-1194-02); Instruction Manual (070-1977-00).

ADDITIONAL ACCESSORIES
CRT Implosion Shield – Clear. Order 337-1440-00 ..... **$5.25**
Socket Adapters – See Adapters Section on page 403.
Cart – Order K218 ..... **$695**
Camera – Order C-9 Opt. 1A and Opt. 07 ..... **$710**

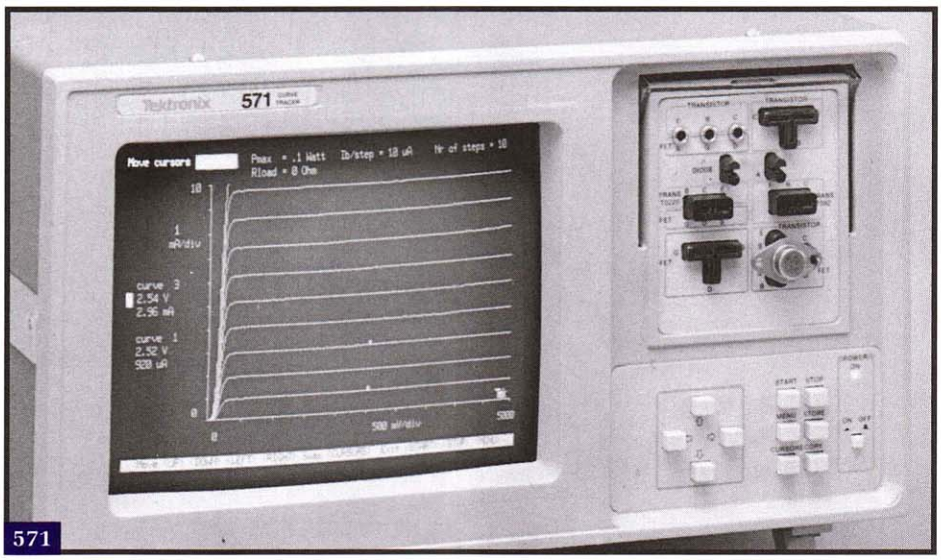
To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

Curve Tracer

Ideal for Educational Laboratories!

571

- Easy to Operate
- Menu Driven
- Non-Volatile EEROM Store 12 Test Setups
- Accurate Cursor Measurements
- Hard Copy Output to Printer
- Built-in Safety Features
- Built-in Test Sockets



571

571 Curve Tracer

The 571 Curve Tracer is designed to accurately display the characteristics of two and three terminal semiconductor devices at a very affordable price. This easy-to-operate curve tracer is ideally suited for testing diodes, transistors, and thyristors.

Characteristic curves are digitized and displayed on a large video display CRT.

The 571 Curve Tracer is extremely versatile, yet remarkably easy to operate. Two main display screens are provided. The first screen is a menu page for selecting the device type and all relevant parameters. Parameters are selected and modified by a simple front-panel keypad entry.

The second screen displays the measured data – a family (set) of curves. The collector voltage and current parameters can be easily changed without switching back to the menu screen. An operator prompt line is provided at the bottom of each screen to indicate which push-buttons are active.

Up to 12 parameter setups (12 completed tests) can be stored in non-volatile EEROM memory to speed up testing of frequently used devices. One set of characteristic curves can be stored in RAM memory for comparison of one device to another (reference device).

A complete set of device adapter sockets are an integral part of the front-panel, preventing possible misplacement.

Characteristics

Collector Supply – 0.5 to 100 volts in 8 ranges, max 2 A @ 50 V, 1 A @ 100 V.

Selectable Load Resistor – 0.3, 10, 100 Ω and 1, 10 kΩ.

Base Drive – Max 10 steps, 0.5 μA/step to 20 mA/step both source and sink in 15 ranges.

Gate Drive – 0.1 V/step to 1 V/step positive and negative in 4 ranges.

I_c Measurement – 5 μA to 200 mA/div. in 15 ranges.

Cursors – Two cursors can be moved along the displayed curves. The X and Y position of the cursor will be displayed on the screen. Basic accuracy is 2% of full scale, all mentioned ranges are in 1-2-5 sequence.

Printer Out – Centronics® parallel interface. Output format for Epson® or IBM® compatible.

ORDERING INFORMATION

571

Curve Tracer **$3,350**

Includes: Operator's Manual, Power Cord

INTERNATIONAL POWER PLUG OPTIONS

Opt. A1 – Universal Euro 220 V, 50 Hz ..... **NC**

Opt. A2 – United Kingdom 240 V, 50 Hz ..... **NC**

Opt. A3 – Australian 240 V, 50 Hz ..... **NC**

Opt. A4 – North American 240 V, 60 Hz ..... **NC**

Opt. A5 – Switzerland 220 V, 50 Hz ..... **NC**

See General Customer Information Section for additional description.

ADDITIONAL ACCESSORIES

Printer Cable – 9 ft. Male to Male Centronics. Order 012-1284-00 ..... **$33**

Printer Cable – Shielded. Order 012-0555-00 ..... *1

CART – Order K218 ..... **$695**

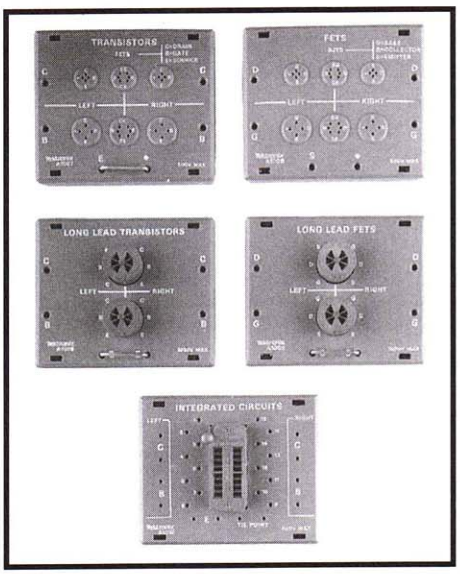
CAMERA – Order C-9 Opt. 1A and Opt. 07 ..... **$710**

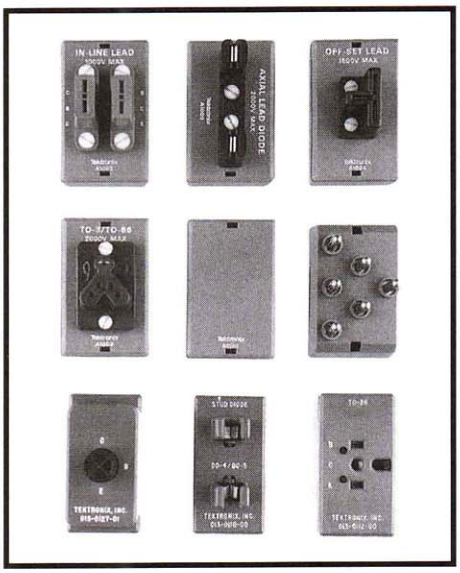
[1]Contact your local Tektronix representative for price information.

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

Semiconductor Testers

Device Adapters





ADAPTERS

- Dual Width Adapters
- Kelvin Sensing Adapters
- SMT Device Adapters

Adapters for 370A, 371, and 577D1 Curve Tracers and SMT Devices.

DUAL WIDTH ADAPTERS

Adapters A1006 through A1010 fit the side-by-side terminals on test fixtures of the 370A and 577D1 Curve Tracers. These adapters allow either 1 or 2 devices mounted in the adapter which is useful for alternating comparisons of two devices.

A. Transistor Adapters for Bipolar Transistors and some MOSFETs – Order A1007 ..... **$315**

B. FET Adapter for most FETs – Order A1009 ..... **$310**

C. Long Lead Transistor Adapter for Transistors with Untrimmed Leads – Order A1006 ..... **$290**

D. Long Lead FET Adapter for FETs with Untrimmed Leads – Order A1008 ..... **$315**

E. Integrated Circuit Adapter for Multi-Pin Dual-in-Line Device Packages – The pins are connected to the collector, base or emitter terminals with patch cords. A tie point is also provided for an external power supply or signal source connection to the IC pins. Includes one each lead for connecting auxiliary supply to the tie points (196-3067-00); six each 4-inch test leads (012-0310-00). Order A1010 ..... **$445**

SMT DEVICE ADAPTERS

SOT-23 Adapter for Surface Mount Devices – Order A1023 ..... **$265**

TO 252/SMT DPack Adapter for Surface Mount Devices – Order A1024 ..... **$265**

KELVIN SENSING ADAPTERS

These adapters fit the test fixtures of the 370, 371 and 577D1 Curve Tracers.

NOTE: For adapters A1001 through A1004 order with Option 01 for use with the 177 plug-in.

A. In-line Adapter – Accepts large and small TO-220 transistors with in-line leads. Spacing between leads is 0.06 inch to 0.18 inch. The adapter is wired for both B-C-E and C-B-E lead configurations. Order A1002 ..... **$180**

B. Axial Lead Diode Adapter – Order A1005 ..... **$180**

C. Offset Lead Adapter for Power Transistor – Order A1004 ..... **$180**

D. TO-3/TO-66 Adapter for Power Transistors – Order A1003 ..... **$180**

E. Blank Adapter for mounting Custom Sockets – Order A1001 ..... **$95**

F. Example showing adapter bottom 6th pin for Base/Gate Kelvin Sensing.

NOTE: The three adapters that follow should only be used with the 177 plug-in.

G. Transistor Adapter Accepts Long or Short Lead Transistors – Can be rewired to fit non-standard configurations. Order 013-0127-01 ..... **$250**

H. Stud Diode Adapter – Order 013-0110-00 ..... **$160**

I. TO-36 Adapter – Order 013-0112-00 ..... **$160**

A1023 SOT-23 Adapter.

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

J17 J1803 J1805/06 J1811/12 J1820 Photometer

The new J17 builds on 20 years of Tektronix experience in light measurement.

The J17 is smaller and has built in features typical of products costing much more.

J17

- Improved Photoptic Spectral Response (Patent Pending)
- Interchangeable Pre-calibrated Measurement heads
- Accurate Spectral and Cosine Corrections
- CIE Color Measurement Head
- Metric/US Unit Conversions at a Touch of a Button
- Auto-Range, Auto-Zero
- Large LCD with Backlight
- RS-232 Output

BENEFITS

- Easy to Read in Dark Areas
- Rugged, Handheld
- Adaptable to Many Light Measurement Needs

New J17

J17 Photometer

The Tektronix J17 is a new Portable Handheld Digital Photometer/Radiometer/Colorimeter capable of making a wide range of light measurements — in the laboratory, in the field, or in the production area. A J17 system consists of a J17 handheld and one of several interchangeable heads which connect directly to the J17. At the heart of the J17 is a microprocessor that is capable of performing several functions at the touch of a front panel button: Metric-to-English conversion, auto-range, auto-zero, hold, and conversion between color coordinate systems.

Several pre-calibrated plug-in heads are available for measuring illuminance, irradiance, luminance, radiance, light emitting diode output, and color using CIE coordinates (u'v' or xy). Connection of a head to the J17 automatically selects the correct front panel measurement units. The large liquid crystal display can be easily read in low ambient conditions using the built-in backlight.

All measurement heads use silicon photodiodes spectrally corrected with multi-element glass filters for maximum long-term stability and accuracy.

The RS-232 output can be utilized in conjunction with a PC for automated testing and data recording.

Under normal usage, the internal 9 volt battery will operate the J17 for thirty hours. For extended operation, the optional AC power supply is recommended.

The J17 is a replacement for the Tektronix J16. The J17 measures a wider range of light levels with greater versatility, and ease of use. It is smaller, lighter, and has longer battery life. All environmental and accuracy specifications equal or exceed those of the time proven J16.

J1803 8° LUMINANCE HEAD

- TV and Computer Display Screens
- Projection Screens
- Surface Reflectance

The J1803 measures luminance in candelas/m^2 (nit) or foot-lamberts where light scattered or emitted by a surface must be measured. The head is pointed at the emitting surface.

The head's spectral response is very closely matched to the CIE photopic curve, ensuring accurate results even when measuring spectrally different light sources.

The acceptance angle is approximately 8 degrees, which is determined by internal field stop apertures. Providing that the 8 degree field is uniformly filled, the probe can be held at any distance from the source. The 8 degree acceptance angle represents about a 1.7 inch diameter field at one foot and is proportionately larger at greater distances. The minimum measurement area is about 0.5 inch diameter with the J1803 in contact with the surface to be measured using the supplied suction cup.

J1805 HEAD FOR LEDS

- Output of Red, Yellow, Green, and Blue LEDs

The J1805 measures luminous intensity in candelas or millicandelas.

Four inserts are supplied with the J1805 to fit common sizes of LEDs (2 each 0.120 inch, and 0.200 inch diameter). These inserts are made of plastic that can be easily modified by the user for other LED sizes or similar light sources.

In the J1805, the silicon photodiode-filter combination provides an excellent match to the CIE photopic curve. Note: For infrared LEDs, use the J1812 probe.

TD

Product also available within 24 hours through TekDirect. Call 1-800-426-2200

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

Photometer

J17 | J1811/12
J1803 | J1820
J1805/06

J1806 8° RADIANCE/RADIANT INTENSITY HEAD

- Display Color Balance

The J1806 is useful for verifying or resetting color balance of displays once initial display color characterization has been done using the J1820.

J1811 ILLUMINANCE HEAD

- Highway Illumination
- Luminaires and Lamps
- Workstation Illumination
- Light Trespass
- Office Lighting

The J1811 is an illuminance head with readout in footcandles or lumens/m^2 (lux). A multi-element glass filter and silicon photo-diode ensure a close match to the CIE photopic curve (color corrected) for accurate measurement of spectrally differing light sources including trichromatic fluorescent, sodium, metal malide, etc. The silicon-sensor recovery time is virtually instantaneous; low-light levels can be measured immediately after exposure to bright sunlight. The wide sensitivity range allows measurement of light levels from moonlight to bright daylight.

The angular response is accurately cosine corrected, simulating an ideal 180° field-of-view detector. The low-profile sensor has a leveling indicator to ensure accurate measurements where a significant proportion of the illumination comes from sources at low angles to the horizon such as roadway lighting.

A six-foot cable between the J1811 head and the J17 allows the user to be out of the field of view while making measurements.

J1812 IRRADIANCE HEAD

- Laser Experiments
- Radiant Efficiency
- Infrared LED Testing

The J1812 measures irradiance in milliwatts/m^2 or output power in milliwatts. The spectral response is flat from 450 to 950 nanometers within ±8%. The response is typically down 50% at 400 and 1030 nm.

J1820 CHROMATICITY HEAD

- Measurement of Chromaticity and White Balance of color monitors
- Color Temperature of Light Sources

The J1820 is for measurement of color coordinates in the 1931 CIE and 1976 CIE-UCS chromaticity systems. Three stable silicon sensors, each with multi-element glass color filters, closely match the CIE standard observer tristumulus functions. Color coordinates are automatically computed and displayed in either x and y or u' and v' units. Luminance in cd/m^2 or footlamberts may also be measured by selecting the desired function with a keyboard button.

The J1820 has approximately a 16° acceptance angle, making it ideal for measurement of computer and television display color. The 16° angle represents a spot of about 3.4 inch diameter per foot of distance. The minimum measurement area is about 1 inch with the head in contact with the surface to be measured. This allows integration over a large enough area on a display to average a number of individual pixels. A rubber suction cup allows the J1820 to be fastened directly to the display screen.

J17 J1803 J1805/06 J1811/12 J1820 Photometer

HEAD CHARACTERISTICS

Application	Illuminance	Irradiance	Luminance	LED	Radiance	Chromaticity
Probe	J1811	J1812	J1803	J1805	J1806	J1820
US Range	0.001 to 9,999 footcandles	N/A	0.1 to 999,990 footlamberts	N/A	1 mw/M²/SR to 1.6 Kw/M²/SR	Luminance same as J1803
Metric	0.01 to 99,990 lumens/m² (lux)	0.01 to 9,999 milliwatts/m²	1 to 9,999,000 candelas/m² (nits)	1 micro-candela to 999.9 candelas	1 mw/M²/SR to 1.6 Kw/M²/SR	0 to 0.999 x, y, u', v'
Accuracy (Including J17)	Within 5% of NIST standards and ±2 digits in last place. Calibrated with an Illuminant A light source.	Same as J1811 except calibrate with a 762 nm filter.	Within 5% of NIST standards and ±2 digits in last place. Calibrated with an Illuminant A light source	Within 5% of NIST standards and ±2 digits in last place. Calibrated with an Illuminant A light source.	Same as J1811, except calibrated with a 656 nm filter.	0.018 x, y, u', v' Illuminant A.
Spectral Response	CIE photopic curve	Flat within ±8% from 450 to 950 nm	CIE photopic curve	CIE photopic curve	Flat within ±8% from 450 to 750 nm	CIE Tristimulus functions
Acceptance Angle	Cosine corrected (180°)	50% sensitivity at 48° off axis	8° (1.7 in. diam/ft; minimum area of 0.5 in.)	8°	8° (1.7 in. diam/ft; minimum area of 0.5 in.)	16° (3.4 in. diam/ft; minimum area of 1 in.)
Features	6 ft. cable	6 ft. cable	3.5 ft. cable Suction cup Light occluder	0.120 in. and 0.200 in. LED adapters, 3.5 ft. cable	3.5 ft. cable	Rubber suction cup for fastening to the display screen, 3.5 ft. cable
Linearity	Within 2% over entire range enabling single point calibration					

ORDERING INFORMATION

J17
LumaColor Photometer
Includes: Battery, and Operator's Manual ..... TD **$950**

J1803
Luminance Head
Includes: Suction Cup, Retainer/Filter Holder, Light Occluder and Operator's Manual ..... TD **$550**

J1805
LED Head
Includes: Four Adapters for the most common LEDS, Rubber Retainer and Operator's Manual ..... TD **$550**

J1806
Radiance/Radiant Intensity Head
Includes: Rubber retainer for holding customer supplied 1 in. diameter filters and Operator's Manual ..... TD **$550**

J1811
Illuminance Head, cosine and photopic corrected.
Includes: Cover, Operator's Manual ..... TD **$675**

J1812
Irradiance Head
Includes: Cover, Operator's Manual ..... TD **$675**

J1820
Color Head
Includes: Suction Cup and Operator's Manual ..... TD **$1,450**

ADDITIONAL ACCESSORIES
Also see Accessory Section.
RS-232 Cable – Order 012-1411-00 ..... **$55**
AC Supply – 120 V. Order 119-5032-00 ..... **$26**

TD
Product also available within 24 hours through TekDirect. Call 1-800-426-2200

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

Accessories

With Tektronix, the Difference is Measurable.

Whether you're using a scope from our revolutionary 11000 Series, our portable 2400 or 2200 Series, or our new TDS and TAS Series, you've invested in the finest line of measurement instruments available. That's why it doesn't pay to compromise performance with accessories you can't be sure of.

A dependable probe is essential to completing your test system—because even the most advanced scope can only be as precise as the data that goes into it. Off-the-shelf general-purpose probes are frequently unreliable, and are not expressly designed for your scope. They can cost you in ways you never bargained for: greatly impaired measurement results, embarrassing errors, and expensive delays.

PLUG IN PEACE OF MIND

Only genuine Tektronix probes measure up to your Tektronix scope, with designed-in compatibility and identical standards for quality—for performance you can always depend on.

Of course, choosing the *right kind* of probe is equally important, which is why we offer the world's largest and most respected line—passive and active voltage probes, current probes, high voltage probes, opto-electrical converters, specialty probes, and SMT and fixtured probes designed for dense circuitry. All are built with the kind of ruggedness, reliability and long life that add up to the best probe value on the market. And they're complemented by an amazingly wide array of probe accessories for virtually every need.

DOCUMENTATION

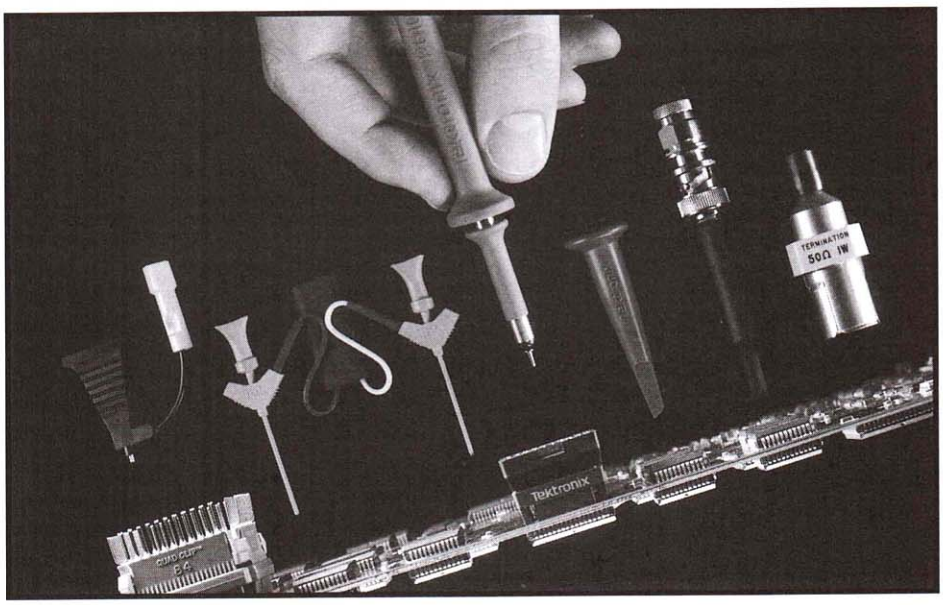
We also provide a complete family of products for documenting your measurement results, a step that's become almost as essential as testing itself. As with our probes, only Tektronix digitizing systems, film-based cameras, printers, and plotters are precision-matched to your instrument and applications. They're exceptional values, too, as are TEK SCOPE-MOBILE® carts and workstations which free up bench space and make equipment easy to share and move around.

SUPPORT IN EVERY SENSE OF THE WORD

Tektronix products come with all the back-up you could ever need—generous warranties, optional extended service plans, and parts and service that are always readily available. Plus the convenience of Tektronix' worldwide field office network for in-person product demos, service, and other assistance.

Even more than that, expert personal guidance is as close as your phone, anytime you need help in choosing and using Tektronix products. And we're always ready to assist you with the widest choice of training materials in the industry.

An extra measure of performance, compatibility, quality, and support—added value that increases your productivity without raising your costs. That's the competitive advantage you get with every Tektronix product.



CONTENTS

DOCUMENTATION DEVICES
Film-based Cameras 408
Recommended Camera Adapters....410
Digital Camera Imaging System....411
Video Hard Copy....414
Four Color Plotter 416

INSTRUMENT CARTS 418

PROBES
Scope to Probe Selection Guide....424
Master Probe Spec Chart....426
Active Probes....428
Low Capacitance Probes....436
Power Supplies....438
Differential Amplifier....439
Spring Contact Probes/Fixtured....440
SMT Probing and Interconnects 442

POWER MEASUREMENTS 444
Current Probes 446
Time Interval to Voltage Converter....450
Differential Probes 452
High Voltage Probes 454
Voltage Isolator....456
Specialty Probes 459
Word Recognizer Probes 460
Passive Probes 461
Microwave Probes 468
Probe Replacement Parts List....472
Probe Accessories 474

OTHER ACCESSORIES
Adapters/Connectors 480
Attenuators 482
Viewing Hoods....484
Light Filters....485
Rackmount Kits 486
Travel Kits....488

Film Based Camera

C-30BP Instrument Camera

Photographic documentation for most Tektronix oscilloscopes.

C-30BP

- Adaptable to Many Applications Instruments
- Ease of Use
- 0.7 to 1.5 Mag Ratio, Continuously Variable
- High Resolution Lens
- Swing Away Hinges

APPLICATIONS

- Single Shot and Fast Transition Capture from 2465B or 2467B Oscilloscopes
- Legal Proof

C-9

- Instant Documentation
- Small, Easily Shared
- Legal Proof
- Convenient Print Size
- Many Hoods Available
- Flash Available
- Motorized Back Available

APPLICATIONS

- Clean Rooms
- Scope Data Archival
- Patient Areas

TD

C-9 also available within 24 hours through TekDirect. Call 1-800-426-2200

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

Option 01 with corrector lens off.

C-30BP Oscilloscope Camera

The C-30BP is an easy to use, compact, high resolution camera which uses Polaroid film packs. It provides versatility for use with most any CRT, and presents a large image size.

The C-30BP is the only Tektronix camera with continuously variable magnification (from 0.7 to 1.5) to give you the greatest photographic flexibility.

The C-30BP camera features dual swing-away hinges which allow it to be swung out of the way, either to the left or to the right, for direct viewing of the CRT. By using supplied or optional bezel adapters, the camera will mount on a variety of scopes, spectrum analyzers, display monitors and other CRT-based instruments.

The C-30BP comes standard with 3.25 inch x 4.25 inch pack film back. An optional Graflock back can be used with various film holders such as 4 inch x 5 inch or wet developed film rolls.

The standard C-30BP is used with older 400 Series Oscilloscopes that have 0.8 cm/div. CRTs: 453, 454, 485 and 491.

C-30BP Option 01 is used on 2445, 2455, 2465 and 2467 Oscilloscopes, as well as older 455, 464, 465B, 466, 468 and 475A scopes.

C-30BP Option 01 is optimized for use at 0.8 magnification only.

Characteristics

Aperture – Variable from f/1.9 to f/16.

Lens Speed – f/1.9.

Magnification – Variable from 0.7 to 1.5 (0.8 magnification on Opt. 01 with C-30BP set to 1.0 magnification).

Resolving Power – (At 1:1 magnification) At Center: at least 25 lines/mm. At Corners: at least 10 lines/mm.

Relative Light-Gathering Ability – 1.0 (0.9 on Opt. 01).

Shutter – Mechanical: 1/125 s to 1 s, bulb and time.

Synchronization Output – X-sync contact closure.

Field of View – Standard: 7 cm x 9 cm. Opt. 01: 8 cm x 10 cm.

PHYSICAL CHARACTERISTICS

Dimensions	mm	in.
Width	191	7.5
Height	130	5.1
Depth	254	10.4
Weights ≈	**kg**	**lb**
Net	2.2	4.8
Shipping	4.1	9.0

C-9 Oscilloscope Camera

The C-9 is a CRT camera which uses Polaroid film packs. It provides documentation for most CRT displays.

The C-9 comes standard with a 3.25 inch x 4.25 inch pack film back.

The C-9 camera can be used with most Tektronix oscilloscopes, as well as most widely used CRT instrument displays. Hoods are available as options to fit Tektronix oscilloscopes.

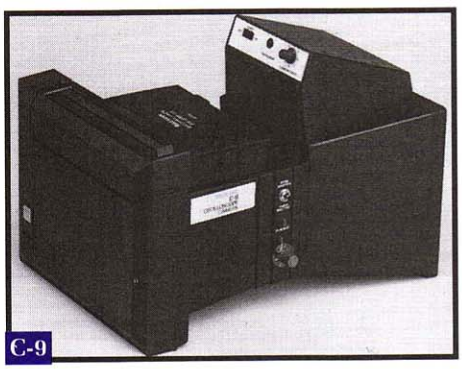
A motorized film back is also optional for use in clean room environments and to reduce handling. A Polaroid AutoFilm system is incorporated to automatically eject a clean, dry, self-developed print. No peeling, timing or coating is necessary. There is no need to handle, tear apart or worry about chemical contaminations with Option 1A.

When one hand is busy, use a pistol grip. Option 1P allows the operator to take a picture with only one hand free. If both hands are busy, the foot switch is available separately, also.

For scopes without graticule lighting, a flash unit is available. The variable xenon flash makes the CRT phosphor glow, which evenly backlights the graticule. This option is available for the small portable scopes as well as the 7K laboratory type scopes. Order Option 1F.

Film Based Cameras

C-9 Instrument Camera



Characteristics

Aperture – Fixed at f/11.

Lens – Fixed-focus, three element.

Magnification – .55 or .73.

Geometric Distortion – Less than 0.5%.

Relative Light-Gathering Ability – .035.

Shutter – Electronic; timed mode from 0.1 to 5 seconds and manual exposure.

Power – Eight AA alkaline batteries (not included).

Resolving Power – At least 6 lines/mm at center, 3 lines/mm at the corners.

PHYSICAL DIMENSIONS OF SCOPE HOODS

C-9 Hood Option	Scopes Supported	Height Inside (cm)	Height Outside (cm)	Height Inside (in.)	Height Outside (in.)	Width Inside (cm)	Width Outside (cm)	Width Inside (in.)	Width Outside (in.)	Mag. Ratio
C9-04	TDS400	10.40	10.60	4.09	4.17	13.80	14.00	5.43	5.51	0.71
C9-05	TDS5/6/800	10.80	11.20	4.25	4.41	14.10	14.50	5.55	5.71	0.71
C9-07	7K	13.03	13.67	5.13	5.38	14.22	14.86	5.60	5.85	0.70
C9-11	11K, CSA, DSA	12.29	12.80	4.84	5.04	15.75	16.26	6.20	6.40	0.73
C9-20	Portable	10.49	11.18	4.13	4.40	11.94	12.67	4.70	4.99	0.51

RECOMMENDED POLAROID FILM PACKS

Back Type	Film Type	ISO Speed	Color	Wide Gray Scale	Contrast	Special	Prints	Order #	Price
AutoFilm	331	200		√	Low	Self-timing	200 60	006-6816-00 006-6815-00	**$260** **$70**
AutoFilm	337	3200		√	High	Clean room	200 60	006-7350-00 006-7349-00	**$210** **$63**
Manual	612	20,000			High	Panachromatic	24	006-6822-00	**$50**
Manual	667	3000			Medium	Coaterless	400 48	006-6825-00 006-6824-00	**$470** **$60**
Manual	669	80	√	√*	Medium	*Extended dynamic range	48	006-6826-00	**$77**

AutoFilm™ is a trademark of the Polaroid Corporation.

ORDERING INFORMATION

C-30BP – Camera **$2,180**
Includes: Polaroid pack film back with split image focus plate (122-0752-02); Mounting Adapter (016-0306-01); Instruction Manual (070-2825-00)
Opt. 01 – Expanded Field of View ..... **+$94**
Includes: Mounting Adapter (016-0269-03) and Corrector Lens (352-0341-01)

ADDITIONAL ACCESSORIES
Carrying Case – Order 016-0587-00 ..... **$200**
Porta Lens – Order 016-0246-02 ..... **$45**
Cable – X-sync. Order 012-0364-01 ..... **$37**
Conversion Kits –
Opt. 01 to Standard. Slip off corrector lens, remove mounting adapters, add new mounting adapter. For new mounting adapter order 016-0306-01 ..... **$125**
Standard to Opt. 01. Includes adapter (016-0269-03); corrector lens (352-0341-01). Order 016-0301-01 ..... **$160**
Bezel Adapter –
4.125 in. (vertical) by 4.6 in. (horizontal). Order 016-0269-03 ... **$155**
5.0 in. (vertical) by 5.5 in. (horizontal). Order 016-0248-01 ..... **$155**
Replacement Film Back – Fits Polaroid 3.25 in. x 4.25 in. pack. Order 122-0752-02 ..... **$245**
Slit Image plate – Fits inside pack back. Order 387-0893-02 ..... **$10.25**
Polaroid Replacement Roller Assemblies – For solid gray or two-tone gray roller assembly. Order 401-0304-00 ..... **$44**
Graflok Type Film Back – Order 016-0487-00 ..... **$300**
Polaroid #545 Film Holder – 4 in. x 5 in. single exposure film packets. Order 016-0201-01 ..... *1
Polaroid #550 Pack Film Holder – 4 in. x 5 in. pack films. Available from Polaroid. 1-800-343-5000 (US only).
Polaroid #405 Pack Film Holder – 3.25 in. x 4.25 in. Available from Polaroid. 1-800-343-5000 (US only).

Writing Speed Enhancers – Increases film's effective writing speed about three times for ASA 3000 film. Order 016-0284-02 ..... **$320**

C-9 – Camera ..... TD **$470**
Includes: Camera body without hood (a hood is required), Instruction Manual. Order 070-8105-01
Opt. 1A – AutoFilm motorized film back ..... **+$200**
Opt. 1F – Graticule flash unit for use with Opt. 07 and/or Opt. 20 ..... **+$60**
Opt. 1P – Pistol grip handle with trigger ..... **+$75**
Opt. 04 – TDS400 Series scope hood ..... **+$60**
Opt. 05 – TDS500/600/800 Series scope hood ..... **+$60**
Opt. 07 – 7K Series scope hood ..... **+$40**
Opt. 11 – 11K, CSA, DSA Series scope hood ..... **+$70**
Opt. 20 – Portables (2000) Series scope hood ..... **+$40**

ADDITIONAL ACCESSORIES
Foot Switch with 8 foot cable. Order 260-1189-02 ..... **+$25**
AC Power Supply 8 foot to Lemo connector (110 V only). Order 119-1847-02 ..... **$100**
AutoFilm Motorized Film Back – Order 426-2041-04 ..... **$225**
Graticule Flash – Use with 7000 Series and 2000 Series scope hoods. Order 016-0642-02 ..... **$230**
Pistol Grip – Pistol grip hand with trigger. Order 122-0186-01 .... **$75**
Scope Hoods –
TDS400 Series. Order 016-1154-00 ..... **$60**
TDS500, TDS600, TDS800 Series. Order 016-1145-00 ..... **$60**
7000 Series. Order 016-0357-03 ..... **$40**
11000, CSA, DSA Series. Order 016-1099-01 ..... **$70**
2000 Series. Order 016-0359-03 ..... **$40**

WARRANTY INFORMATION
Tektronix one year warranty of all parts under normal operating conditions.

[1]Contact your local Tektronix representative for price information.

TD
C-9 also available within 24 hours through TekDirect. Call 1-800-426-2200

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

Recommended Camera Adapters

RECOMMENDED CAMERA ADAPTERS

Instruments	C-9 Hood	Price	C-30BP Bezel Adapter	Price
300 Series*1	None Available		Opt. 01 016-0327-01	$314
308*1	Not Recommended		Not Recommended	
370, 371	Opt. 07, 016-0357-03	$80	Not Recommended	
400 Series*1	Opt. 20 016-0359-03	$80	Opt. 01 016-0269-03	$249
400 Series with 0.8 cm. graticule: 422, 453, 454, 485, 491*1	None Available		016-0306-01	$125
492A/P, 494/P, 495, 496/P	Opt. 07, 016-0357-03	$80	016-0248-01	$155
500 Series Round*1	None Available		016-0243-00	$153
500 Series Rectangular*1	None Available		016-0244-00	*3
500 Series TV Vectorscopes*1	None Available		None Available	
528A*1	Opt. 07, 016-0357-03	$80	016-0248-01	$155
529, 576	None Available		None Available	
600 Series	Opt. 07 016-0357-03	$80	Opt. 01, 016-0248-01 (NR for 10x12cm size)	$249
1240	Not Recommended		Not Recommended	
1400 Series (not 1480C)	Opt. 07, 016-0357-03	$80	016-0248-01	$155
1500 Series	None Available		Opt. 01, 016-0327-01	$314
1700 Series	Opt. 20 016-0359-03	$80	Opt. 01, 016-0269-03 (NOT 1740 or 1750 Series)	$249
2200 Series	Opt. 20*2 016-0359-03	$80	Opt. 01 016-0269-03	$249
2300 Series	Opt. 1P, 20*2 016-0359-03	$155	None Available	
2400 Series	Opt. 20 016-0359-03	$80	Opt. 01 016-0269-03	$249
2700 Series*1	Opt. 20 016-0359-03	$80	Opt. 01 016-0269-03	$249
2754/55/P Spectrum Analyzers	Opt. 07, 016-0357-03	$80	016-0248-01	$155
5000 Series*1	Opt. 07, 016-0357-03	$80	Not Recommended	
5030, 5031*1	None Available		None Available	
5400 Storage 5403/D41, 5441, D41	Opt. 07 016-0357-03	$80	016-0248-01	$155
7000 Series*1	Opt. 07, 016-0357-03	$80	Opt. 01 016-0248-01	$249
7000 Large-Screen 7403, 7603, 7603N	Opt. 07 016-0357-03	$80	Not Recommended	
11300 Series	Opt. 07, 016-0357-03	$80	Not Recommended	
11400 Series	Opt. 11, 016-1099-01	$140	Not Recommended	
CSA Series	Opt. 11, 016-1099-01	$140	Not Recommended	
DSA600 Series	Opt. 11, 016-1099-01	$140	Not Recommended	
OF100, OF200 TDR	Opt. 07, 016-0357-03	$80	Not Recommended	
R7103	Opt. 07, 016-0357-03	$80	016-0248-01	$155
T900 Series*1	Not Recommended		None Available	
T922R	Opt. 07, 016-0357-03	$80	016-0248-01	$155
TAS400	Opt. 06, 016-1181-00	*3		
TDS300, TDS400	Opt. 04, 016-1154-00	$120		
TDS500, TDS600, TDS800	Opt. 1P, 05, 016-1145-00	$195		
TM500 SC502, SC503, SC504	None Available		Opt. 01 016-0327-01	$249
WFM300	Opt. 20, 016-0359-03	$40	None Available	

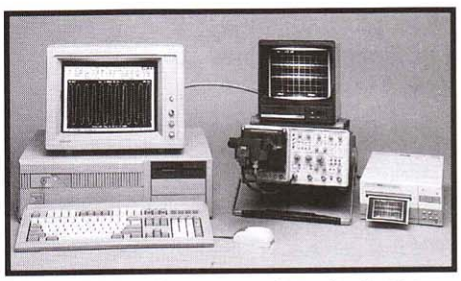
*1 *See next entry*

*2 *Opt. 1F recommended for scopes with no graticule lighting. The first and last small graticules may be cut off the picture image on some oscilloscopes.*

*3 *Contact your local Tektronix representative for price information.*

Digital Camera Imaging System

DCS01	DX01
C1002	DX02
DX05	MUX16



The Digitizing Camera consists of a C1002 Video Camera, a DX01 Frame Store Board inside the PC, DSC01 software, and cables. The system shown includes the DSC01, TEK2467B scope under GPIB control from the DSC01 software, and a DX05 video monitor.

DCS01 Digital Camera Imaging System

The DCS01 high-speed transient capture system is incredible on the Tektronix "bright-eye" oscilloscopes. Coupled with a 2467B with Option 10 (GPIB), you need never touch the front panel of the scope as you change settings and test conditions.

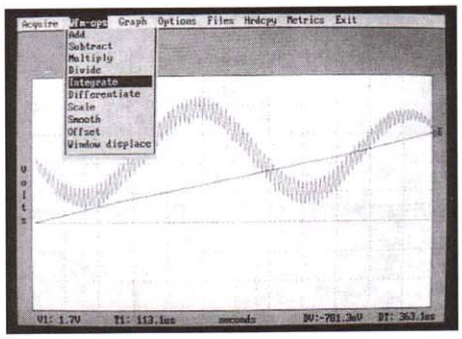
A DCS01/2467B digital scope system has greater than 400 MHz system bandwidth, even with picosecond risetimes in single-shot applications. The sampling speed is 100 GS/s, effective since the system is REAL TIME.

A DCS01/7104 digital scope system is the ultimate in transient capture! At 250 GS/s and 1 GHz bandwidth, no other REAL TIME digital system can provide accuracies beyond 99%.

The DCS01 provides a CCD camera (C1002) with 728 x 490 resolution and 256 gray levels. Also included is a full-size PC board compatible with XTs to 486 machines which captures the video data in a 512 x 512 array of 256 gray levels. Powerful software then analyzes the video data to decide where the waveform actually was, and to compensate for all the optics involved to within 1% error via a system calibration.

The waveform is presented in high resolution color graphics, with up to 22 pulse measurements made automatically. Built-in hardcopy procedures document the results on printers and plotters, and the camera view can be archived using the HC02A video hardcopy unit.

The award-winning manual and multitude of utility software programs are included when you order the DCS01.



Manipulate waveforms mathematically by using such procedures as integration, differentiation, addition, and subtraction with DCS01GPH.

DCS01 Software

DCS01GPH is a standard part of the DCS01. The installation program helps you set up your specific system, and load programs and batch files for your ease. The commands are presented in drop-down windows, and can be accessed with a mouse. The waveforms are presented in high resolution color graphics with up to 22 pulse parameters automatically computed 1 second after the two cursors have been positioned on the waveform graph. Hardcopy routines to Epson, IBM, HPGL and LaserJet are provided.

DCS01LIB provides you with source code and object libraries to build your own application software. You are in full control of the DCS01 hardware. You have complete control of the acquisition process, can read and write to the video memory on board, and can trigger or be triggered in many ways.

DCS01GEN is a text-only environment targeting fast data logging and multiple channels. Up to 256 channels can be controlled using a laptop and MUX16 units.

C1002 Camera

The C1002 camera is a 728 x 490 CCD array digitizer. A seven-element lens provides 0.3% distortion, eliminating keystoning and other optical geometric distortion problems. The focal range provides for near-infinity as well as CRT imaging. It is used with telescopes and electron microscopes. The camera is encased in a rugged body, and mounted using the same adapters as the C-30BP camera. Thus, the C1002 can be easily swung away from the CRT either left or right for easy viewing. The standard NTSC (RS170) video can be used with VCRs, TVs, and video hardcopy units (see HC02A).

DCS01

- Fast Transient Capture
- Digitize Analog Signals
- Computerized Data and Calculations
- Inexpensive DSO with Accuracies of Analog
- Installs in PC clones
- to 250 GS/s, 1 GHz Bandwidth
- More Accurate than Scope
- Fast & Powerful
- Three Triggering Methods: Save-on-Delta, Save-on-Light and Scope Gate Out

APPLICATIONS

- Logging Waveform Data
- Biomed, Physical Research
- Electrostatic Discharge Testing
- Imaging and Analysis
- A/D Education
- Presentations
- Long Record Length (VCR)

MUX 16

- One host can control up to 256 DCS01 frame store boards (16 MUX16s)
- Supports up to 16 DCS01 boards
- Is fully programmable over GPIB

Combines the best of analog and digital capabilities in a powerful waveform digitization and analysis system.

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

GPIB IEEE-488 — The MUX16 complies with IEEE Standard 488.1-1987, and with Tektronix Standard Codes and Formats.

DCS01 | DX01
C1002 | DX02
DX05 | MUX16

Digital Camera Imaging System

DX02 CAMERA POWER SUPPLY
The DX02 is used when a computer is unnecessary to view and capture video. This rugged power supply provides power and video output for two C1002 cameras. Long record length is what you need? Try a 20-hour VCR! This DX02/C1002 solution is also appreciated when making presentations using large screen TVs or for multi-media educational presentations.

DX01 FRAME STORE BOARD
The DX01 board's REAL TIME video data passthrough or capture controlled by the software as 30 Hz interlaced video is sent to it from the C1002 camera. The captured data is stored in a 512 x 512 array of 256 gray levels. The eight-bit interface allows the board to be used in lowly XTs or high-powered 486 clones. An analog section on the board produces traceable calibration signals which are used in system calibration, mapping the entire video image in terms of geometrically corrected positioning. The board also senses a scope trigger out signal, and is used to reset the scope for single-shot events. DELTA TRIGGERING is available on a real-time basis, providing Save-on-Delta capability against previously acquired waveforms. Also, incoming video can be summed REAL TIME by the board, extending low-light capabilities.

Characteristics (DCSO1)

DIGITIZING CAMERA SYSTEM
The following specifications are valid when the camera system is operated at a temperature between 0°C and 40°C.

Digitizing Technique – Scan conversion.

System Writing Speed – To the bandwidth of the 2467B or 7104, even in single-shot mode; other scopes are dependent on their photographic writing speed of the CRT and phosphor, but to their full bandwidth on repetitive signals.

Geometric Distortion – Calibrated signals less than 1%.

Relative Light – Gathering Ability - 1.0.

"Shutter" – Electronic; software controlled from 1/60 of a second to infinity.

Power - Provided by PC environment.

Resolving Power – 12 bits vertical nominal resolution, 512 points horizontal when calibrated.

Multiple Channels – To the PC's limit of available slots; to 16 channels with MUX16; to 256 channels with DCS01GEN or DCS01LIB and MUX16.

Throughput Rate – 3 Hz (to 5 Hz).

Waveform Display – Up to 6 in colors in Hercules, CGA or EGA displays.

Calibration Signal – Traceable; (during cal procedure) into 50 ohms: 20 KHz ±0.1%, vertically from 100 to 800 mV in 100 mV steps at ±0.2%.

Scope Reset Signal – 12 V pulse.

Power Requirements – +12 V for DX01 and C1002 at <300 mA; -5V at <35 mA; +5 V at <4.0 A. Total is less than 18.0 W.

Computer Compatibility – At least: IBM XT, 1MB RAM, DOS 2.1, graphics capability; mouse, high capacity drives, 286 or better recommended. Video memory segment exclusion from memory managers required with DOS 5.0 and above. A National Instruments GPIB board (PCIIA) is required for use with a 2467B with Opt. 10 (GPIB).

Characteristics (C1002)

Focal length – 10 mm at 5200 Å.

F Number at Infinity – F/1.3.

Object-to-Image Distance – 1633.54 mm at 0.075X, 144.72 mm at 0.833X.

Field of View (Variable Mag.) – 7.2 cm x 9.0 cm and 8.0 cm x 10.0 cm.

Spectral range – 350 nm to 1100 nm, 400 nm to 600 nm within 3 dB.

Angular Range – 23.45°

Distortion – Within 0.3% at image plane.

Lens Resolution – Center: 100 lines/mm. Edge: 20 lines/mm.

Imaging Device – Solid State, inter-line CCD.

Pixels – 490 vertical by 728 horizontal.

Resolution – 480 vertical lines by 540 horizontal lines.

S/N Ratio – Typical: 52 dB; minimum 50 dB. Gamma=1.

Sensitivity – 2.5 LUX.

Video Output – 1 Vp-p composite video, 75 Ω.

PHYSICAL CHARACTERISTICS

Dimensions	mm	in.
Width	120	4.8
Height	104	4.1
Depth	241	9.5
Weight	**kg**	**lb**
With scope mounting adapter	1.4	3.0

Characteristics for DX02 and DX01

CAMERA POWER SUPPLY AND VIDEO INTERFACE

Number of Cameras Supported – 1 or 2.

Output per Camera – +12 V ±5% at 0 to 600 mA with 1 mV ripple or less at 500 mA load.

Video Out – 75 Ω feedthrough from each camera.

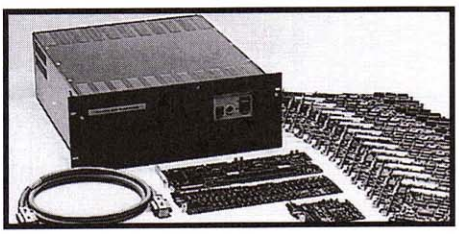
Input Power Requirements – At 88 to 270 VAC, 40 to 440 Hz, 24 W maximum.

Safety Certifications – UL, CSA, VDE.

EMI Compliance – Qualifies under test limits specified for VDE 0871, Class B, emissions limitations.

Digital Camera Imaging System

DCS01	DX01
C1002	DX02
DX05	MUX16



MUX16

The MUX16, in conjunction with a host controller, is part of a programmable multiple-channel digitizer system. Users can control up to 256 DCS01 (DX01) frame store boards and/or GPIB instruments with one host controller.

OPERATION

The MUX16 is designed to be used with a host controller. The host controller must have a compatible GPIB interface card capable of system controller/controller in charge operation. DCS01 software supports IBM PCs or compatibles as the host controller.

The MUX16 mainframe is a talker/listener to the controller via GPIB. The DX01 Frame Store Boards acquire video images. The waveform data is uploaded to the host controller for additional processing and/or storage.

GPIB instruments can be controlled by the host via the MUX16 by the use of a PC-IIA board to interface to the scopes. MUX16 software options have GPIB support for the 11302A and 2467B scopes.

Characteristics

POWER REQUIREMENTS

User configurable. Fan cooled.

Line Voltage Ranges – 90 to 130 VAC or 180 to 264 VAC.

Line Frequency – 47 to 83 Hz, single phase.

Power Consumption – 350 W.

PHYSICAL CHARACTERISTICS

Dimensions	mm	in.
Width	4831	9.0
Height	178	7.0
Depth	540	21.2
Weight	**kg**	**lb**
Net	21.8	48
Shipping	21.3	47

ORDERING INFORMATION

DCS01
Digitizing Camera System **$5,890**
Includes: C1002 Camera, DX01 Frame Store Board, DCS01GPH Software (062-9859-01) on 3.5 in. and 5.25 in. disks, 5-Pin Cable (174-0449-00), three SS-to-BNC Cables (174-0430-00) and Operator's Manual (070-6175-01). Requires optional camera to bezel adapter; see below.

Opt. 1A – Bezel Adapter for 11302, 5K and 7K scopes. (016-0248-01) ..... **+$130**

Opt. 2A – Bezel Adapter for Tek 2400 Series and scopes with 8 cm x 10 cm CRTs. (016-0269-03) ..... **+$135**

Opt. 3A – Bezel Adapter for Tek 485 Series and scopes with 7 cm x 9 cm CRTs. (016-0306-01) ..... **+$145**

SOFTWARE

Windowed Color Graphics – DCS01GPH. Included with DCS01. Order 062-9859-01 ..... **$960**

Source Code and Object Library – DCS01LIB. For custom applications. Order S58DC01 ..... **$595**

Text-Only Interface – DCS01GEN. For logging data on many channels. Order 062-9828-00 ..... *2

ADDITIONAL ACCESSORIES

2467B with Opt. 10 – 400 MHz "BrightEye" Oscilloscope. See pages 118-122. ..... **$13,990**

RIC386 with Opt. 10 – Instrument Controller. See pages 261-275. ..... **$2,490**

C1002
High Resolution CCD Video Camera **$3,590**

C1002R
Ruggedized version of the C1002 ..... **$4,100**
Both cameras include: Camera Cable (174-0449-00), Instruction Manual. Requires optional Bezel Adapter(s) and external power (Opt. 04).

Opt. 1A – Bezel Adapter for 7104. (016-0248-01)
C1002 ..... **+$130**
C1002R *2

Opt. 2A – Bezel Adapter for 2467 and scopes with 8 x 10 cm CRTs. (016-0269-03)
C1002 ..... **+$135**
C1002R *2

Opt. 04 – DX02 Camera Power Supply and Video Interface (Note: Please select one of the A1 through A5 power plug options.) ... **+$295**

DX02
Power supply for two C1002 cameras **$385**

DX01
DCS Frame Store Board **$2,490**
Includes: DCS Frame Store Board, three BNC to SS cables (174-0430-00), Operator's Manual.

Opt. 01 – DCS01 Software (A C1002 and DX01 with Opt. 01 is equivalent to a DCS01). ..... **+$929**

DX05
Video Monitor **$330**
Opt. A1 – Power plug, Universal Euro (220 V, 50 Hz) ..... **NC**

HC02A – Video Copier. See page 414 ..... **$3,100**

HC100 – Four Color HPGL Plotter with cable (Opt. 02) see page 416 ..... **$1,128**

ADDITIONAL ACCESSORIES

Extra Length C1002/2R to DX01 Cables –
4 meter. Order 174-1368-00 ..... **+$190**
6 meter. Order 174-1369-00 ..... **+$150**

GPIB Board Kits – GPIB driver board and software to install in PC to communicate with MUX16. Driver software has been modified to operate with the MUX mainframe. (PC-IIA GPIB board and driver). Order 021-0452-00 ..... **+$495**

MUX16
Rackmount Multi-Channel DCS Mainframe, 110 V ..... **+$7,675**
Includes: 18 open slots; 80286 CPU; Chassis slide; PC-III GPIB; Instruction Manual; power cord; 2 m GPIB cable

Opt. 04 – GPIB Low-Speed Interface Card (PCIIA) for MUX to instrument control ..... **+$656**

Opt. 10 – DCSGen Software*1 (MS-DOS) ..... **+$1,025**

Opt. 11 – DCSGraph Software*1 (MS-DOS) ..... **+$1,075**

*1 *On 5 1/4 in. and 3 1/2 in. disks.*

*2 *Contact your local Tektronix representative for price information.*

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

Video Hardcopy

HC02A and HCM08 Video Hardcopy System

From multiple video displays to only one Video copier – introducing the new HCM08.

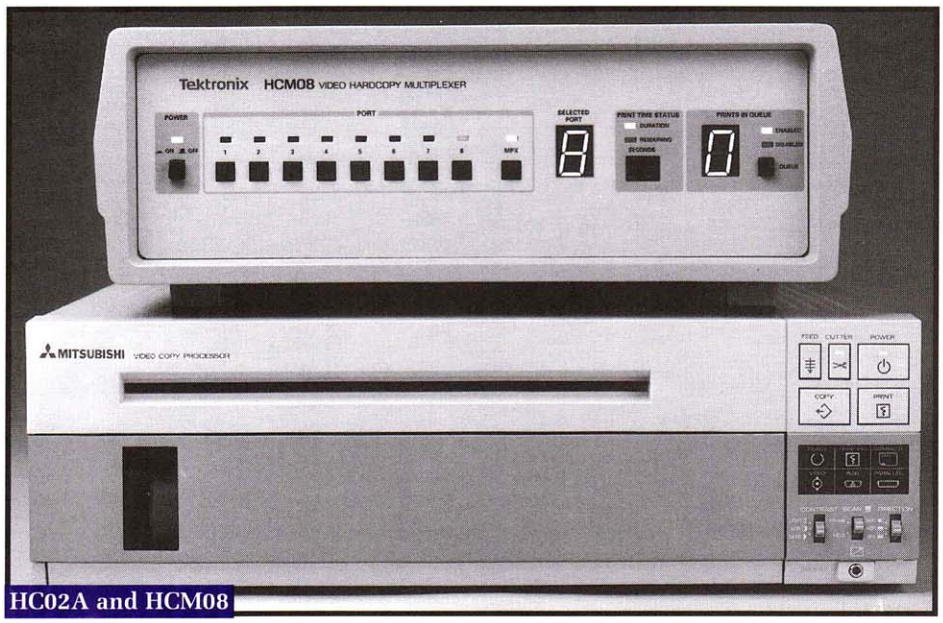
From video terminal displays or IBM PC VGA or Mac IIs – introducing the new HC02A.

HC02A

- Archivable thermal prints
- Modular system
- Safety certified
- 8 inputs to one copier
- 256 grey levels, resolution to 544 x 640 lines on output
- HC02A can also copy from:
  - IBM PC
  - Macintosh II
  - Television
  - VCR
  - Camcorder

APPLICATIONS

- Direct replacement for Tektronix 4632 copiers
- Multiplex input from:
  - Tektronix terminals
  - Foxboro terminals
  - IBM terminals
  - DEC terminals
  - HP terminals



HC02A and HCM08

HC02A

The Tektronix HC02A copier with the Option 01 (HCM08) multiplexer unit provides the copying capability of the 4632 silver-paper copier with newer technology conveniences and much higher resolution.

USE UP TO EIGHT VIDEO SOURCES WITH EACH COPIER.

The HCM08 is an integral part of the HC02A Option 01 video copying system. The HCM08 video multiplexer is Tektronix-designed, and provides plug-compatibility with the 4632 copier protocol. This hardcopy multiplexer also provides active circuitry which maintains the video signals at 0 dB, as well as a queuing feature for up to ten images at a time. The queue is processed after each image has been copied.

With the HC02A copier in autocut mode, the copier only needs to be tended when the paper supply runs out.

The HCM08 multiplexer unit, which is also available as the HC02A Option 01, provides adjustable timing control allowing the copier to complete the printing process and, optionally, to cut the paper. The time between copies can be adjusted from 5 seconds to 50 seconds, allowing the use of different copiers and copier capabilities.

The HCM08 has the following inputs:

- Eight BNC video inputs
- Eight 15 pin D connectors for 4632-compatible protocol
- One timing adjustment knob for printing delay

The HCM08 has the following outputs:

- One hardcopy trigger to HC02A
- One BNC video output to HC02A

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

Video Hardcopy

HC02A and HCM08 Video Hardcopy System

THE HISTORY OF TEKTRONIX/ MITSUBISHI COPIERS

The HC02A video copy processor is a Mitsubishi product, the P78U model. Tektronix has marketed many Mitsubishi products over the past seven years, and our customers have found them all to be exceptional values. As imaging technology has grown, so has the offerings from Mitsubishi. We are proud to be able to offer Mitsubishi's very latest, highest-resolution grey-scale copier for your needs.

HARDCOPY DOCUMENTATION/ARCHIVAL FROM ALMOST ANY SOURCE

The HC02A (Mitsubishi P78U) can copy from almost any video source by autoscanning frequencies from 15 to 35 kHz in the horizontal and 45 to 80 Hz in the vertical.

The thermal print is on plastic paper, and can be stored for at least 5 years and up to 7.

The HC02A can copy from composite video such as NTSC, PAL and SECAM inputs as well as from TTL, RGB analog and parallel inputs.

An IBM PC video display in MDA, HGC, CGA, EGA, MCGA or VGA can be used as the source display signal, also Macintosh II computer display signals can be copied.

The Foxboro terminals used commonly in process control applications are a perfect fit, as the 25 pin connectors on the HCM08 multiplexer unit are directly plug-compatible.

Television signals from TV, VCR or camcorder can also be used as the copier has special circuitry to lock onto these noisier signals. Adjustments can be made for black-level, white-level, sharpness, AGC, fields, dithering and even averaging of video signals.

IMAGE SIZES AND RESOLUTION

The HC02A (Mitsubishi P78U) can copy in a multiple format, providing smaller 3 inch x 4 inch images printed in the same time as one large 6 inch x 8 inch image. The large print can be made in reverse, sideways or normal directions.

The HC02A is programmable to adjust for the specific type of input signal. The height and width can be adjusted as well as horizontal and vertical shifts, field/frame, contrast, image resolution and even a comment line on the printout.

The HC02A grey scale levels can be controlled between 2, 64 and 256 levels.

ORDERING INFORMATION

HC02A

Mitsubishi P78U High-Resolution Video Copier **$3,100**

Opt. 1 – Video Copier 8:1 Multiplexer unit (HCM08) ..... **+$1,500**

HCM08

Video Copier Multiplexer **$1,900**

WARRANTY

HCM08 – Tektronix one year warranty.

HC02A – Mitsubishi warranty covers parts and labor for six months

ADDITIONAL ACCESSORIES

Cables – 50 Ω

10 in., male to male. Order 012-0208-00 ..... **$22**
18 in., male to male. Order 012-0076-00 ..... **$31**
24 in., male to male. Order 012-1342-00 ..... **$55**
36 in., male to male. Order 012-1341-00 ..... **$45**
36 in., precision (1%) male to male. Order 012-0482-00 ..... **$35**
42 in., male to male. Order 012-0057-01 ..... **$28**
18 in., male to female. Order 012-0208-00 ..... **$22**
10 in., BNC male to BSM female. Order 012-0127-00 ..... **$40**

Cables – 75 Ω

24 in., male to male. Order 012-1339-00 ..... **$45**
36 in., male to male. Order 012-1338-00 ..... **$45**
42 in., male to male. Order 012-0074-00 ..... **$31**
60 in., male to male. Order 012-1337-00 ..... **$45**

Cables – 93 Ω

42 in., male to male. Order 012-0075-00 ..... *1

Paper –

Super Quality. Order K70S *1
High Density, Black Dye. Order K75H *1
High Density, Blue Dye. Order K75HM *1

[1]Contact your local Tektronix representative for price information.

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

Four Color Plotter

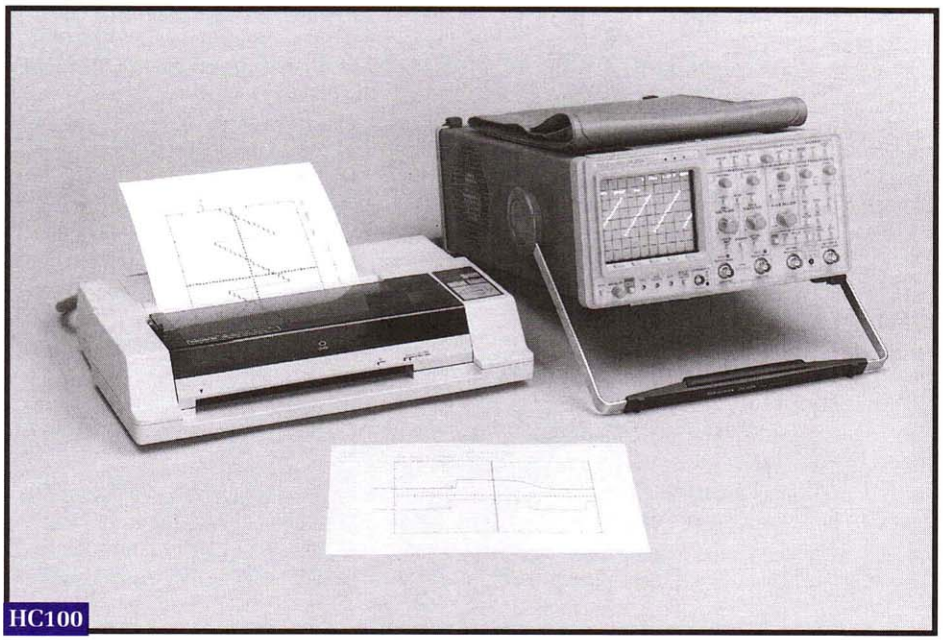
Hard Copy at the Touch of a Button!

HC100

- Direct Plots from Many Tek Digitally-Based Instruments Without Using a Controller
- Standard HC100 Interfaces:
  - Centronics Parallel
  - Interface GPIB Interface
- Opt. 03 Interface:
  - RS-232C Serial Interface
- Handles A4 and US Letter Size
- Makes Direct Plots in About 90 Seconds
- Compact Size
- Four plotting modes, including HPGL
- Inexpensive
- Fast and Accurate

APPLICATIONS

- Documentation from Digitally-Based Instrumentation for Reports or Presentations



HC100

Direct Waveform Plotting

The Tektronix HC100 Color Plotter is a low-cost, four-color plotter designed to make waveform plots directly from a variety of Tektronix digitizing instruments without requiring an external controller. Under program control from the attached instrument's front-panel or keyboard, the HC100 provides plots of digitally stored waveforms and printouts of instrument setup information.

FUNCTIONS

Drawing Modes: Plotter (HP-GL, Epson HI 80, Graphtec commands sets), printer (Epson RX-80 compatible), self tests (HP-GL and standard plotter). The HC100 is shipped in the HP-GL mode.

Plotter operation is supported by HP-GL (Hewlett-Packard Graphics Language). Tek codes and formats are also supported on the GPIB interface.

Other modes in the HC100 include Graphtec emulation and Epson RX80 printer mode.

Printer operation is Epson RX-80 compatible and is supported by a full ASCII 96-character set. International character sets for 11 countries can be selected as well. HC100 handles printer functions to format and print text, but it does not support dot graphics.

Both graphics and text can be plotted in color. There are three types of pens used: fiber-tip pens with water-based ink for paper, fiber-tip pens with oil-based ink for overhead projection film, and ball-point pens with water-based ink for paper. Ball point pens produce a finer line than a fiber pen. Additional or replacement pens are available through Tektronix.

The HC100 pen cartridge holds four pens. The pens can be different colors, ink types, or point styles. The pen cartridge is easily changed allowing you to quickly change colors or pen types.

The HC100 cannot be used in a multi-controller environment, such as with a GPIB instrument and GPIB controller, unless attached to the controller (IBM PC or equivalent). Multiple GPIB controllers on one bus does not conform to IEEE-488 standards.

TD

Product also available within 24 hours through TekDirect. Call 1-800-426-2200

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

Four Color Plotter

Characteristics

Effective Drawing Size – 267 mm (X-axis) x 192 mm (Y-axis).

Maximum Drawing Speed – 230 mm/s (along pen axis).

Maximum Resolution – 0.1 mm.

Pen Response Speed – 15 times/s.

Number of Pens – 4 (changed automatically).

Pen Types – Fiber pens: aqueous ink or oil-based ink; Ball-point pens: aqueous ink.

Pen Colors – Set of black, blue, red, and green.

Paper Sizes – ISO A4: 297 mm x 210 mm; B5: 257 mm x 182 mm; US letter size: 279 mm x 216 mm.

Paper Types – Ordinary paper; OHJ film.

Pen Movement Precision – Single Pen: 0.3 mm; Different Pens: 0.5 mm.

Pen Change Precision – Within 0.3 mm.

RELIABILITY

Pen Lifetime – Aqueous fiber pen: ≈ 200 m; Oil-based Fiber Pen: ≈ 400 m; Aqueous ball-point pen: 400 m.

RS-232C BOARD SPECS

Asynchronous – Bit Rate: 75 BPS to 19,200 BPS. Note: HC100 Opt. 03 is set at 9,600 baud. Buffer: 32K.

POWER REQUIREMENTS

Line Voltage – Standard: 117 VAC ±10%; Options A1-A5: 220 V/240 VAC ±10%.

Line Frequency – 49.5 Hz to 60.5 Hz.

Power Consumption – 30 W.

PHYSICAL CHARACTERISTICS

Outside Dimensions	in.	cm
Width	16.5	41.5
Height	3.2	8.1
Depth	10.8	27.2
Weight	**lb**	**Kg**
	13.2	6

ORDERING INFORMATION

HC100

Color Plotter..... TD **$1,075**

Includes: 1 package of each Pen Set: Fiber tip/water based (016-0879-00); Fiber tip/oil based (016-0878-00); Ball point (016-0877-00); Operator's Manual (070-6441-00); One pen cartridge (016-0876-00)

Opt. 01 – 1M GPIB Cable. Order 012-0991-01 .....**+$105**

Opt. 02 – DB-25 M to Centronics M Cable for PCs. Order 012-1250-00 (Both Opt. 01 and 02 may be ordered) .....**+$53**

Opt. 03 – Deletes GPIB I/F Board, and adds RS-232C I/F Board; includes DB-9 to DB-25. RS-232 Cable. Order 012-1298-00 .....**NC**

Opt. 04 – Parallel Cable for use with oscilloscopes .....**+$30**

Opt. 05 – Serial Cable for use with oscilloscopes .....**+$36**

For a 220 V/240 V, 50 Hz version order one of following options:

INTERNATIONAL POWER PLUG OPTIONS

Opt. A1 – Universal Euro 220 V, 50 Hz.....**NC**

Opt. A2 – United Kingdom 240 V, 50 Hz .....**NC**

Opt. A3 – Australian 240 V, 50 Hz.....**NC**

Opt. A4 – North American 240 V, 60 Hz.....**NC**

Opt. A5 – Switzerland 220 V, 50 Hz .....**NC**

See General Customer Information Section for additional description.

ADDITIONAL ACCESSORIES

Extra Pen Cartridge – Order 016-0876-00 .....**$22**

Pens – Four colors (black, red, green, blue) in each package:
Fiber tip, aqueous ink. Order 016-0879-00.....**$12.25**
Fiber tip/oil-based ink. Order 016-0878-00 .....**$12.25**
Ball point/aqueous ink. Order 016-0877-00.....**$12.25**

Pens – black, four
Fiber tip, aqueous ink. Order 016-0939-00.....**$12.25**
Fiber tip, oil-based ink. Order 016-0940-00.....**$12.25**
Ball-point, aqueous ink. Order 016-0941-00 .....**$12.25**

Interface Board Kits – Has all the parts necessary to install the board in the HC100. It includes the interface board, mounting hardware, and installation instructions.
GPIB Interface Board Kit. Order 021-0457-00 .....**$315**
RS-232C Interface Board Kit. Order 021-0458-01 .....**$395**

Cable – Data cable. 10 ft., male to male with 9-PIN DB connectors. Order 174-0537-01 .....**$20**

HC100 Technical Manual – Order 070-6441-00.....**$70**

TD
Product also available within 24 hours through TekDirect. Call 1-800-426-2200

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

Instrument Carts/Workstations

CONTENTS

K212 Portable Instrument Cart 419
K217S Rack Instrument Cart 419
K218 Instrument Cart, TDS 500/600/800 Series.....420
K220 Rack Instrument Cart.....420
K318 PC Cart 421
206 Utility Cart.....421
K636 Rackmount Mobile Workstation 422
K335BN PC/Instrument Cart.....422

Instrument Carts and Workstations

Tektronix can free up your valuable work space, make sharing and moving equipment easy, and get you closer to the device under test.

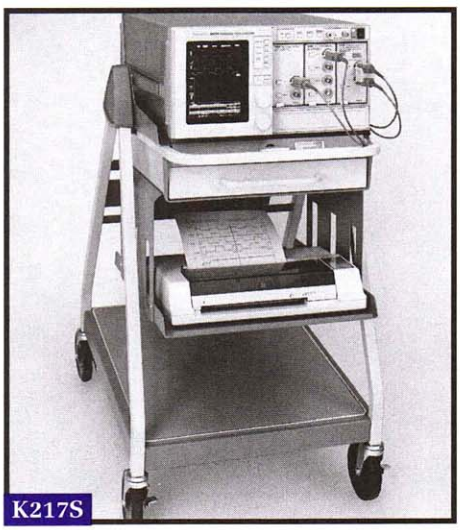
Our Scopemobiles® and workstations are designed with instrument integration and ease of use in mind and are built to the highest standards in materials and pride of ownership in the industry today.

INSTRUMENT COMPATIBILITY

	206/K318	K212	K217S	K218	K220	K335BN	K636	92Cart
Oscilloscopes/Digitizers								
11000 Series CSA	•		•		√			
DSA 600 Series	•		√					
2200/2400	•	√		•		•		
305/314/336	•	√		•				
5000/7000 Cabinet	•			√				
5000/7000 Rackmount	•				√		•	
TDS 400 Series	•	√		•				
TDS 500, 600, 800	•			√	•			
Terminals/Color Printers								
4200 Series	•					√		
4600 Series	√							
4900 Series	√							
Television/Spectrum Analyzers								
1410R			•		√	•		
1430/1440/1450/1470	•				√	•		
1480 Series Cabinet		√						
1480 Rackmount	•				√		√	
17XX Cabinet		√						
17XX Rackmount	•				√		•	
1910	•		•		√			
27XX Series			•	√				
49X Series		√						
Logic Analyzers								
1230			•		√			
DAS 9200						•		√
LV500	√							
Prism 3000						√		
Curve Tracers								
370A/371	•		•		√			
577			•	√	•			

• – *Compatible*
√ – *Recommended*

Instrument Carts/Workstations



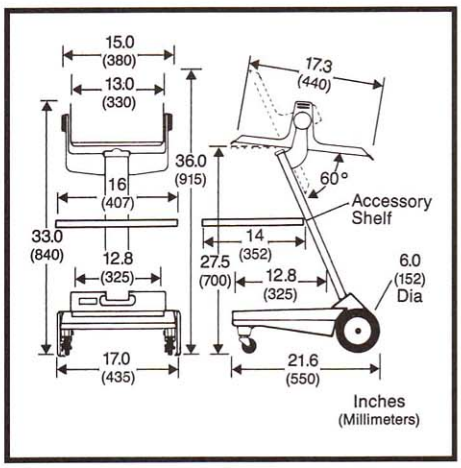
K212

- For All Portable Instruments
- Sturdy and Mobile Platform
- Enhances Sharing and Work Space
- Tiltable Top Tray
- Locking Front Casters
- Four Outlet Power Strip Option

K217S

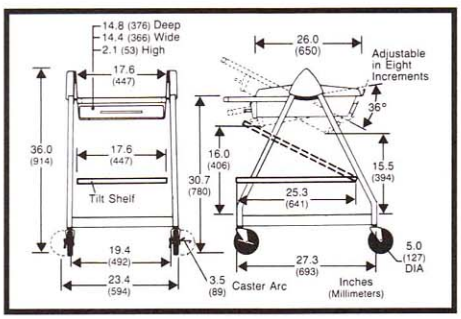
- For Rack-Width Instruments
- Stable/Mobile Platform
- Four Outlet Power Strip
- Accessories Drawer

Increase your efficiency and decrease clutter with Tektronix Scopemobiles®.



Low Cost Portability

The K212 column and trays are made from high strength aluminum, the base is thermoset polyester. The base and trays are Tektronix Blue; column and yoke, silver grey.



Rack Width Durability

These sturdy, portable carts are ideal for manufacturing, research and design environments. The tiltable middle tray on the K217S is rack width to accommodate additional instruments. The trays are extra long to accommodate oversize instruments.

TD

K212 available within 24 hours through TekDirect. Call 1-800-426-2200

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

ORDERING INFORMATION

K212

Portable Instrument Cart ..... TD **$395**

Includes: Two 1 in. x 5 ft. Securing Straps, Retaining Bar, Instruction Sheet, and Probe Holders.

Opt. 10 – Add four Outlet Power Strip ..... **+$75**

Opt. 12 – Add Second Tray ..... **+$80**

Opt. 22 – Combines Opt. 10/12 ..... **+$145**

Power Strip Retrofit Kit – Order 016-1025-00 ..... **$95**

Middle Tray Retrofit Kit – Order 016-1026-00 ..... **$110**

K217S

Rack Instrument Cart **$780**

Includes: Probe Holders, Securing Strap.

Instrument Carts/Workstations

Stable and safe instrument mobility.

K218

- Specifically Designed for the TDS 500/600/800 Series of Oscilloscopes
- Tiltable Top Shelf with Positive Lock
- Accessories Drawer
- Rubberized Smooth Rolling 4 inch Casters
- 4 Outlet Power Strip
- Sturdy All Metal Construction

K220

- Sturdy, Mobile Instrument Platform
- 3 Rack-Width Trays
- 4 Outlet Surge Protector
- Locking Wheels
- 4 Securing Straps
- Accessories Drawer

K218

K220

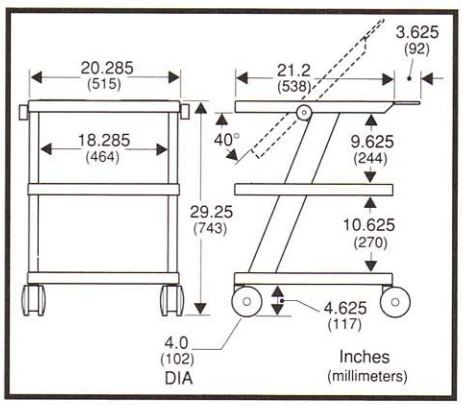
TDS 500/600/800 Scopemobile®

The K218 cart is designed specifically to provide stable support and transport for Tektronix TDS 500/600/800 oscilloscopes. The top shelf has a perforation pattern which matches the ventilation pattern in the base of the TDS Scopes.

The sturdy K218 cart provides stable and safe instrument mobility with smooth rolling 4 inch casters. The tiltable top shelf has 4 positive locking positions between horizontal and 25 degrees. The K218 comes complete with an accessories drawer, a four-outlet surge protected power strip, four securing straps and two probe holders. The K218 is shipped with casters and handle unattached; assembly instructions and hex keys are included.

Portability For Large Oscilloscopes

The sturdy K220 cart provides stable and safe instrument mobility with smooth rolling 4 inch casters. The tiltable top shelf has 4 positive locking positions between horizontal and 25 degrees. The K220 comes complete with an accessories drawer, a four-outlet surge protected power strip, four securing straps and two probe holders. The K220 is shipped with casters and handle unattached; assembly instructions and hex keys are included.



To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

ORDERING INFORMATION

K218

TDS 500 Series Cart **$695**

Includes: Instruction Manual, Probe Holders, 4 Retaining Straps, Retainer Bars, and 2 Hex Keys.

Opt. 05 – Delete power strip ..... **–$25**

K220

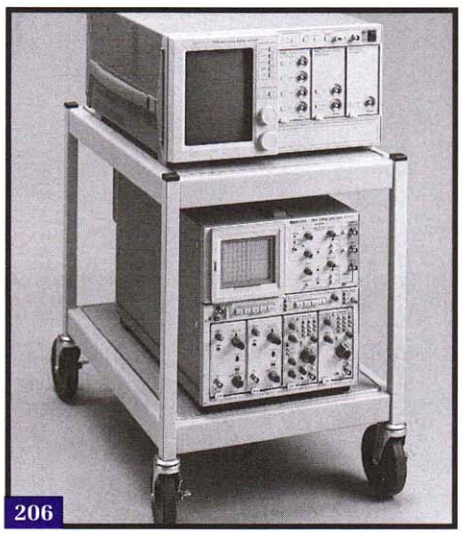
3–Shelf Rack Instrument Cart **$695**

Includes: Probe Holders and 4 Securing Straps

Keyboard Tray – Order 436-0240-00 ..... **$80**

Opt. 05 – Delete power strip ..... **–$25**

Instrument Carts/Workstations



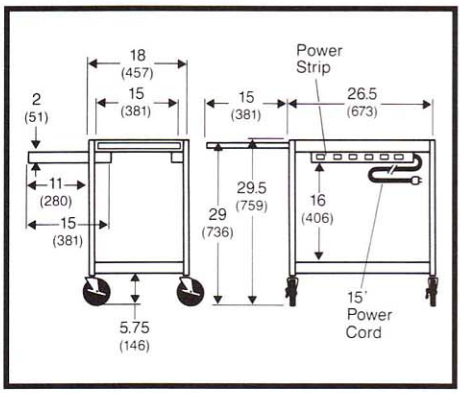
K318

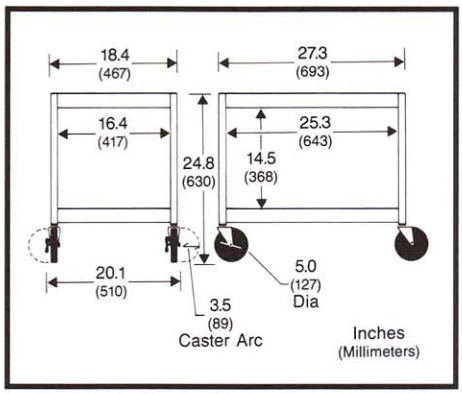
- Designed for Computers, Peripherals, Test and Measurement Equipment and Industrial Uses
- Plastic Laminate on Both Surfaces
- Four Outlet Power Strip
- Locking Wheels
- 200 lb Load Capacity
- Keyboard/ Accessories Drawer
- Strong/Stable Slide-out Shelf

206

- Low Profile Cart (25 in. Height Std.; 30 in. Height Optional)
- Plastic Laminate on Both Surfaces
- Locking Wheels
- Stable/Sturdy Platform

General Purpose Utility Carts for the lab or the desk.





PC Portability

This table height platform includes keyboard drawer, power strip, and pull-out shelf. The K318 is a handsome, sturdy addition to your work environment.

General Purpose Utility

The quality and workmanship is evident in this general purpose utility cart. If you need a cart that lasts, the 206 is the one for you.

ORDERING INFORMATION

K318
P.C. Cart **$470**
Opt. 05 – Delete power cord ..... **–$25**

206
Utility Cart **$295**
Opt. 05 – 30 in. height ..... **NC**

Probe holders included in the K318 and 206.

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

K636
K335BN

Instrument Carts/Workstations

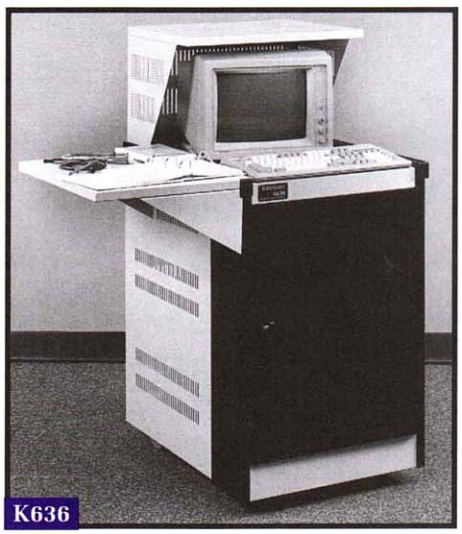
Moveable Rackmount capability for the test bench.

K636

- Rugged Mobile Workstation for Rackmount Applications
- Extremely Soft Ride with Balloon Cushion-Back Wheels
- Standard Top Shelf
- Pop-out Side and Back Panels
- Surge Protector
- 3.5 Inch Recessed Front Vertical Supports
- Optional Side Shelf Pops On and Off Either Side

K335BN

- Incredibly Strong and Attractive
- Adjustable Height and Configuration
- Four 2.375 Inch Casters (2 Locking)
- Cable Management Clips; Tools for Assembly Included
- Optional Slide-out Shelf, Wire Base, and 5 Inch Extension Tubes Add Versatility and Functionality.
- 5-Year Warranty



K636

Rackmount Workstation

This handsome rackmount workstation provides up to 26 inch of rack space, 24.5 inch with keyboard platform.*1 The optional side shelf attaches to the extrusion, is easily removable, and can be mounted on either side. (The side shelf is rated at 40 lbs. and measures 16 in. x 22.5 in.) The K636 cart breathes from the sides and back eliminating any vacuum-cleaner-effect.

*1 *Includes drawer slides and hardware.*

K335BN

Adjustable Height Instrument Cart

K335BN is bone in color with putty grey legs and base. A 1 inch laminated top and molding edge make the K332BN an attractive addition to any work area. Add options to best solve your platform needs.

PHYSICAL CHARACTERISTICS

	in.	mm
Height	35	88.9
Width	25	63.5
Depth	30	76.2

ORDERING INFORMATION

K636

Mobile Work Station **$1,250**
Includes: Probe Holder and Securing Strap.
Opt. 05 – Flush-Mount Adapter Kit ..... **+$70**
Opt. 06 – Delete Power Strip ..... **NC**
Opt. 10 – Side Shelf ..... **+$130**
Opt. 11 – 23.5 in. high Smoked Plastic Door*1 ..... **+$180**
Opt. 12 – 26 in. high Smoked Plastic Door*1 ..... **+$190**
Opt. 13 – 3.5 in. deep Drawer*2 ..... **+$215**
Opt. 14 – 7 in. deep Drawer*2 ..... **+$225**
Opt. 15 – Keyboard Platform*2 ..... **+$135**
Opt. 19 – Blower Cut-Out ..... **+$90**

Back Panel –

1.75 in. high Cover Plate Order 333-1351-07 ..... **$25**
3.5 in. high Cover Plate Order 333-0997-06 ..... **$35**
5.25 in. high Cover Plate Order 333-0999-06 ..... **$40**

K335BN

Compact P.C./ Instrument Cart **$355**
Opt. 10 – Slide Out Shelf ..... **+$105**
Opt. 11 – Wire Base ..... **+$55**
Opt. 14 – (3) 5 in. Extension Tubes ..... **+$50**

*1 *Includes drawer slides and hardware.*
*2 *Door includes popout hinges, attractive handle, and lock.*

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

Probes

Vital Links to Test System Performance

Whether you're using a scope from our high-performance 11000 Series, or the innovative TDS family of bench top and portable DSOs, you've invested in the finest line of measurement instruments available. That's why it doesn't pay to compromise performance with accessories you can't be sure of.

A dependable probe is essential to complete your test system – because even the most advanced scope can only be as precise as the signal that goes into it. Off-the-shelf general-purpose probes are frequently unreliable, and are not expressly designed for your scope. They can cost you in ways you never bargained for – greatly impaired measurement results, embarrassing errors, and expensive delays. Only genuine Tektronix probes measure up to your Tektronix scope with designed-in compatibility and identical standards for quality – for performance you can always depend on.

Of course, choosing the right kind of probe is equally important, which is why we offer the world's largest and most respected line. All are built with the kind of ruggedness, reliability, and long life that add up to the best probe value on the market. And they're complemented by an amazingly wide array of probe accessories for virtually every application.

We also provide a complete family of products for documenting your measurement results, a step that's become almost as essential as testing itself. As with our probes, only Tektronix film-based cameras, printers, and plotters are precision-matched to your instrument and applications. They're exceptional values too, as are Tektronix SCOPE-MOBILE® carts and workstations which free up bench space and make equipment easy to share.

You can depend on Tektronix for designed-in equipment compatibility and consistently high quality. Any item you order, from our top-of-the-line active (FET) probe to the simplest connector is backed by an unparalleled warranty and world wide service network. We have an uncompromising insistence on customer satisfaction.

THE ABC'S OF PROBES (PRIMER)
You can learn about signal acquisition from our comprehensive primer on signal acquisition probes with sections on understanding probe specifications and applications, selecting probes, and advanced probing techniques. Easy to use charts and tables speed the probe selection process for your specific application.

For your free copy, ask your Tektronix sales engineer for literature 60W-6053-3 or call toll-free in the U.S.A. 1-800-426-2200.

ACTIVE PROBES: THEIR UNIQUE CHARACTERISTICS AND APPLICATIONS
(Application Note) Literature # 60W-6883.

PROBING HIGH FREQUENCY DIGITAL CIRCUITRY
(Technical Brief) Literature #60W-8412-0.

PROBE AND SIGNAL CONCEPTS (VIDEO TAPE)
A 53 minute video tape and a companion 40-page booklet describe practical uses of passive, active and current probes. Emphasis is on selecting the correct probe for your application.

To order, ask your Tektronix sales engineer for part number 068-0229-xx specify tape format:
-00 3/4" U-MATIC, -01 Beta, -02 Beta II,
-03 Beta III, -04 VHS NTSC, -06 VHS PAL,
-07 VHS SECAM. Additional booklets are available by ordering Literature number 60W-6770.

CONTENTS

Scope to Probe Selection Guide.....424
Master Probe Spec Chart.....426
Active Probes.....428
Low Capacitance Probes.....436
Power Supplies.....438
Differential Amplifier.....439
Spring Contact/Fixtured Probes.....440
SMT Probing and Interconnects.....442
Current Probes.....446
Time Interval to Voltage Converter.....450
Differential Probes.....452
High Voltage Probes.....454
Voltage Isolator.....456
Speciality Probes.....459
Word Recognizer Probes.....460
Passive Probes.....461
Microwave Probes.....468
Probe Replacement Parts List.....472
Probe Accessories.....474

Oscilloscopes to Probes

Cross Reference

Tektronix Scopes to Tektronix Probes.

Highlighted probes are those normally shipped with the scope. For non-highlighted probes, the scope bandwidth may be limited by the probe shown. Use scope's bandwidth and probe specification chart to determine overall probe/scope bandwidth.

RECOMMENDED PROBES

	Passive 1X	Passive 10X	Passive 1X/10X	SMT 10X	Low-Z	High Volt. 100X	High Volt. 1000X	Active
11000 Series								
11201/A/11A32	P6101B	P6134C	P6063B	P6562		P6009	P6015A	P6204/P6205
11A33		P6135A*4		P6562				
11A34/V	P6101B	P6134C	P6063B	P6562		P6009		P6204/P6205*7
11A52					P6156*2			P6204/P6205
11A72 /11A71					P6156*2			P6204/P6217
11A81					P6156*2			P6204/P6217
SD20/22/24/ 26/30/32					P6150			P6217*5
7000 Series								
7A13	P6101B	P6135A*4				P6009	P6015A	
7A15A/7A18/A	P6101B	P6105A	P6129B			P6009	P6015A	P6202A*1/P6205*5
7A16A	P6101B	P6106A	P6063B			P6009	P6015A	P6202A*1/P6205*5
7A19/7A24					P6156*2			P6201*1/P6217*5
7A22		P6135A						
7A26	P6101B	P6106A	P6063B			P6009		P6202A*1/P6205*5
7A29/P					P6156*2			P6201*1/P6217*5
7A42	P6101B	P6131	P6063B		P6156*2	P6009		P6202A*1/P6205*5
7D15	P6101B	P6106A	P6063B					
7D20	P6101B	P6053C	P6129B				P6015A	
Digitizers								
RDT710A/TD1301					P6156*2	P6009	P6015A	P6205*5
RTD720A					P6156*2			P6204*5
SCD1000					P6156*2			P6217*5
SCD5000					P6156*2			P6217*5
5000 Series								
5A14N	P6101B	P6006/P6102A	P6062B			P6007	P6015A	
5A15N/5A18N	P6101B	P6006/P6102A	P6062B			P6007		
5A21N/5A22N		P6135A*4						
5A26		P6135A*4						
5A38N	P6101B	P6105A	P6129B			P6009		
5A45/5A48/5D10	P6101B	P6105A	P6129B			P6009	P6015A	
2400 Series								
2430/A/M	P6101B	**P6133 Opt. 25**	P6063B	P6562	P6156*2	P6009	P6015A	P6202A*1
2431L	P6101B	**P6136 Opt. 25**	P6063B	P6562	P6156*2	P6009	P6015A	P6201*1
2432/A/M	P6101B	**P6137**	P6063B	P6562	P6156*2	P6009	P6015A	P6201*1
2439	P6101B	**P6136 Opt. 25**	P6063B	P6562	P6156*2	P6009	P6015A	P6202A*1
2440/M	P6101B	**P6137**	P6063B	P6562	P6156*2	P6009	P6015A	P6201*1
2445	P6101B	**P6131**	P6063B	P6562	P6156*2	P6009	P6015A	P6202A*1
2445A	P6101B	**P6133 Opt. 25**	P6063B	P6562	P6156*2	P6009	P6015A	P6202A*1
2445B	P6101B	**P6137** **P6133 Opt. 25*3**	P6063B	P6562	P6156*2	P6009	P6015A	P6202A*1
2455A/B	P6101B	**P6136 Opt. 25**	P6063B	P6562	P6156*2	P6009	P6015A	P6202A*1
2465	P6101B	**P6131**	P6063B	P6562	P6156*2	P6009	P6015A	P6201*1
2465A	P6101B	**P6136 Opt. 25**	P6063B	P6562	P6156*2	P6009	P6015A	P6201*1
2465B	P6101B	**P6137**	P6063B	P6562	P6156*2	P6009	P6015A	P6201*1
2467	P6101B	**P6136 Opt. 25**	P6063B	P6562	P6156*2	P6009	P6015A	P6201*1
2467B/HD	P6101B	**P6137**	P6063B	P6562	P6156*2	P6009	P6015A	P6201*1
2300 Series								
2335/2336	P6101B	**P6108A**	P6119B			P6007	P6015A	
2336YA	**P6101B**	**P6108A**	P6119B			P6007	P6015A	
2337	P6101B	**P6108A**	P6119B			P6007	P6015A	

See footnotes on following page.

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

Oscilloscopes to Probes

Cross Reference

RECOMMENDED PROBES

	Passive 1X	Passive 10X	Passive 1X/10X	Low-Z	High Volt. 100X	High Volt. 1000X	Active
2200 Series							
2201/2206	P6101B	**P6103B**	P6119B		P6007	P6015A	
2210	P6101B	**P6103B**	P6119B		P6007	P6015A	
2211/2212	P6101B	**P6109B**	P6129B		P6009	P6015A	
2213/A	P6101B	**P6122**	P6119B		P6007	P6015A	
2214	P6101B	**P6103B**	P6119B		P6007	P6015A	
2215/A	P6101B	**P6122**	P6119B		P6007	P6015A	
2220	P6101B	**P6109B**	P6119B		P6007	P6015A	
2221/A/2224	P6101B	**P6109B**	P6129B		P6009	P6015A	
2225	P6101B	**P6103B**	P6119B		P6007	P6015A	
2230/2232	P6101B	**P6109B**	P6129B		P6009	P6015A	
2235/A	P6101B	**P6109B**	P6119B		P6007	P6015A	
2235L	P6101B	**P6122**	P6119B		P6009	P6015A	
2236/A	P6101B	**P6109B**	P6129B		P6009	P6015A	
2245/A	P6101B	**P6109B**	P6129B		P6009	P6015A	P6205[*5*8]
2246/A	P6101B	**P6109B**	P6129B		P6009	P6015A	P6205[*5*8]
2247/A/2252	P6101B	**P6109B**	P6129B		P6009	P6015A	P6205[*5]
400 Series							
434	P6101B	**P6105A**	P6129B		P6007	P6015A	P6202A[*1*8]
455	P6101B	**P6105A**	P6129B		P6009	P6015A	P6202A[*1*8]
464	P6101B	P6105A	**P6062B**		P6009	P6015A	P6202A[*1*8]
464/M	**P6101B**	**P6105A**	P6129B		P6009	P6015A	P6202A[*1*8]
465/B	P6101B	**P6105A**	P6129B		P6009	P6015A	P6202A[*1*8]
465/M	**P6101B**	P6105A	P6129B		P6009	P6015A	P6201[*1*8]
466	P6101B	P6105A	**P6062B**		P6009	P6015A	P6202A[*1*8]
468	P6101B	**P6105A**	P6129B		P6009	P6015A	P6202A[*1*8]
475/A	P6101B	**P6106A**	P6063B	P6156[*2]	P6009	P6015A	P6201[*1*8]
485	P6101B	P6106A	P6063B	P6156[*2]	P6009	P6015A	P6201[*1*8]
300 Series							
305/314/335	P6101B	**P6149A**					
336/A	P6101B	**P6148A**					
390AD	P6101B	P6105A	P6129B		P6009	P6015A	
T20X Series							
T20X Series	**P6115**						
TAS Series							
TAS455	P6101B	P6109B			P6009	P6015A	
TAS465	P6101B	P6109B			P6009	P6015A	
TDS 400/500/600/800 Series							
TDS 420/460	P6101B	**P6138**		P6156[*2]	P6009	P6015A	P6205
TDS 520/540	P6101B	**P6139A**		P6156[*2]	P6009	P6015A	P6205
TDS 620/640	P6101B	P6139A		P6156[*2]	P6009	P6015A	**P6205**
TDS 820				P6150			P6206/P6207
TM 500/5000 Series							
AM 502		P6135A[*4]					
DC 503A	P6101B	P6130					
DC 504A/5004	P6101B	P6130					
DC 509/5009	P6101B	P6130					
DC 510/5010	P6101B	P6130					
DC 505/A	P6101B	P6108A					
DC 508/A	P6101B	P6130					
SC 501/2/3	P6101B	P6006/P6102A	P6129B		P6007	P6015A	
SC 504	P6101B	P6105A	P6129B		P6009	P6015A	
SI5010				P6156[*2]			P6202A[*1*8]

*[*1] The P6201 and P6202A active probes require probe power, which is normally supplied by the scope (either standard or optional to the scope). If probe power is unavailable, an 1101A power supply can be used to supply probe power.*

*[*2] The P6156 is standard with 10X attenuation. Other attenuations are available. Order Opt. 25 for 10X plus 100X and see ordering information on page 437 for separate 1X and 20X attenuator tips.*

*[*3] 2445B shipped with P6133 Opt. 25 probe until BW changed to 200 MHz, then shipped with P6137.*

*[*4] Differential Pair.*

*[*5] Requires 1103 TEKPROBE Power Supply. Or for SCD 1000. Order SCD1000 Opt. 1E.*

*[*6] 1 Meg Ω Input Required.*

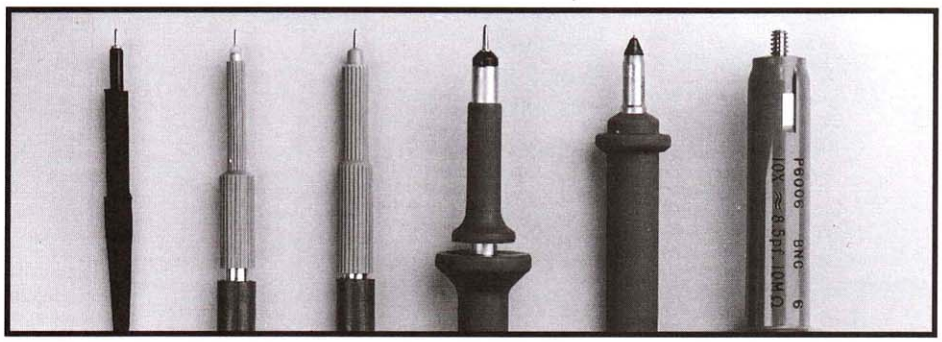
*[*7] 11A34 only.*

*[*8] P6205 plus 1103 power supply is also available.*

Probes
Specifications

Type	Cable Length	Attenuation	Bandwidth at –3dB	Compensation Range	System Input Resistance	Typical Input C	Gnd Ref	Read Out	ID	Max Voltage DC + pk AC	Tip/Head Style
Passive Probes											
P6101B	2 m	1	15 MHz	NA	1 MΩ	100 pF				420 V	Min
10X Passive Probes											
P6103B	2 m	10	60 MHz	15 to 35 pF	10 MΩ	13 pF				420 V	Min.
P6109B	2 m	10	100 MHz	15 to 35 pF	10 MΩ	13 pF		√		420 V	Min.
P6006	2 m	10	25 MHz	15 to 55 pF	10 MΩ	8.5 pF				500 V	Mono.
Opt. 03	3 m	10	25 MHz	15 to 55 pF	10 MΩ	11 pF				500 V	Mono.
Opt. 04	4 m	10	12 MHz	15 to 55 pF	10 MΩ	15 pF				500 V	Mono.
P6053C	2 m	10	250 MHz	15 to 55 pF	10 MΩ	12.5 pF		√	√	500 V	Comp.
Opt. 01	1.5 m	10	250 MHz	15 to 55 pF	10 MΩ	9.5 pF				500 V	Comp.
Opt. 03	3 m	10	250 MHz	15 to 55 pF	10 MΩ	13.5 pF				500 V	Comp.
P6102A	2 m	10	60 MHz	15 to 55 pF	10 MΩ	13 pF	√	√		500 V	Min.
P6105A	2 m	10	100 MHz	15 to 55 pF	10 MΩ	11 pF	√	√		500 V	Min.
Opt. 01	1 m	10	100 MHz	15 to 55 pF	10 MΩ	9 pF				500 V	Min.
Opt. 03	3 m	10	90 MHz	15 to 55 pF	10 MΩ	13 pF				500 V	Min.
P6106A	2 m	10	250 MHz	15 to 55 pF	10 MΩ	11 pF	√	√		500 V	Min.
Opt. 01	1 m	10	250 MHz	15 to 55 pF	10 MΩ	9 pF				500 V	Min.
Opt. 03	3 m	10	150 MHz	15 to 55 pF	10 MΩ	13 pF				500 V	Min.
P6108A	2 m	10	100 MHz	15 to 35 pF	10 MΩ	11 pF				500 V	Min.
Opt. 01	1 m	10	100 MHz	15 to 35 pF	10 MΩ	9 pF				500 V	Min.
Opt. 03	3 m	10	90 MHz	15 to 35 pF	10 MΩ	13 pF				500 V	Min.
P6121	1.5 m	10	100 MHz	20 to 26 pF	10 MΩ	11pF		√		500 V	Min.
P6122	1.5 m	10	100 MHz	15 to 35 pF	10 MΩ	11 pF				500 V	Min.
P6148A	2 m	10	50 MHz	20 to 51 pF	10 MΩ	13 pF		√		500 V	Min.
P6149A	2 m	10	100 MHz	20 to 51 pF	10 MΩ	13 pF	√			500 V	Min.
P6130	2 m	10	250 MHz	15 to 35 pF	10 MΩ	13.2 pF		√		500 V	Sub.
Opt. 01	1.5 m	10	250 MHz	15 to 35 pF	10 MΩ	12.7 pF				500 V	Sub.
Opt. 03	3 m	10	150 MHz	15 to 35 pF	10 MΩ	14.5 pF				500 V	Sub.
P6131	1.3 m	10	300 MHz	14 to 18 pF	10 MΩ	10.8 pF		√		500 V	Sub.
Opt. 02	2 m	10	250 MHz	14 to 18 pF	10 MΩ	13.5 pF				500 V	Sub.
Opt. 03	3 m	10	150 MHz	14 to 18 pF	10 MΩ	14.5 pF				500 V	Sub.
P6133	2 m	10	150 MHz	10 to 25 pF	10 MΩ	12.7 pF		√		500 V	Sub.
Opt. 01	1.3 m	10	150 MHz	10 to 25 pF	10 MΩ	11.4 pF				500 V	Sub.
Opt. 03	3 m	10	120 MHz	10 to 25 pF	10 MΩ	14.5 pF				500 V	Sub.
Opt. 25	1.3 m	10	150 MHz	10 to 25 pF	10 MΩ	10.8 pF				500 V	Comp.
P6134C	1.5 m	10	400 MHz	12 to 18 pF	10 MΩ	11.3 pF		√	√	500 V	Sub.
P6136	1.3 m	10	350 MHz	12 to 18 pF	10 MΩ	10.8 pF		√		500 V	Sub.
Opt. 25	1.3 m	10	350 MHz	12 to 18 pF	10 MΩ	10.8 pF				500 V	Comp.
P6137	1.5 m	10	400 MHz	12 to 18 pF	10 MΩ	10.8 pF		√	√	500 V	Comp.
P6138	1.3 m	10	350 MHz	12 to 18 pF	10 MΩ	10 pF		√		500 V	Comp.
P6139A	1.3 m	10	500 MHz	8 to 12 pF	10 MΩ	8 pF		√		500 V	Comp.
P6562	1.5 m	10	350 MHz	15 to 30 pF	10 MΩ	10.3 pF		√		42 V	SMT

m = meters V = volts MHz = Megahertz MΩ = Mega Ohms pF = picofarads



Tip/Head Style: *Subminiature* *Miniature* *Monolithic* *SMT* *Compact* *4 mm*

Probes
Specification Chart

Type	Cable Length	Attenuation	Bandwidth at –3dB	Compensation Range	System Input Resistance	Typical Input C	Gnd Ref	Read Out	ID	Max Voltage DC + pk AC	Tip/Head Style
1X/10X Switchable Passive Probes											
P6062B	2 m	1/10	6.5/100 MHz	15 to 47 pF	1/10 MΩ	105/14 pF	√	√		500 V	Min.
Opt. 01	1.5 m	1/10	8/100 MHz	15 to 47 pF	1/10 MΩ	100/13 pF				500 V	Min.
Opt. 03	3 m	1/10	4.5/100 MHz	15 to 47 pF	1/10 MΩ	135/17 pF				500 V	Min.
P6063B	2 m	1/10	6/200 MHz	15 to 24 pF	1/10 MΩ	105/14 pF	√	√		500 V	Min.
Opt. 01	1.5 m	1/10	12/200 MHz	15 to 24 pF	1/10 MΩ	80/11 pF				500 V	Min.
P6119B	2 m	1/10	10/100 MHz	15 to 35 pF	1/10 MΩ	100/18 pF				420 V	Min.
P6129B	2 m	1/10	10/100 MHz	15 to 35 pF	1/10 MΩ	100/18 pF		√		420 V	Min.
High Voltage Passive Probes (100X/1000X)											
P6007	2.2 m	100	20 MHz	8 to 55 pF	10 MΩ	2.2 pF				1,500 V	Mono.
Opt. 01	1.2 m	100	25 MHz	8 to 55 pF	10 MΩ	2.0 pF				1,500 V	Mono.
Opt. 03	3.4 m	100	15 MHz	8 to 55 pF	10 MΩ	2.4 pF				1,500 V	Mono.
Opt. 04	4.5 m	100	13 MHz	8 to 55 pF	10 MΩ	2.6 pF				1,500 V	Mono.
P6009	3.4 m	100	120 MHz	8 to 55 pF	10 MΩ	2.5 pF		√		1,500 V	Mono
P6015A	3.8 m	1000	75 MHz	7 to 49 pF	100 MΩ	3.0 pF				40,000 V	HVP
Opt. 1R	3.8 m	1000	75 MHz	7 to 49 pF	100 MΩ	3.0 pF		√		40,000 V	HVP
Opt. 25	9.4 m	1000	25 MHz	7 to 49 pF	100 MΩ	3.0 pF				40,000 V	HVP
Opt. 2R	9.4 m	1000	25 MHz	7 to 49 pF	100 MΩ	3.0 pF		√		40,000 V	HVP

Type	Length	Attenuation	Bandwidth at –3dB	DC Offset Range	System Input Resistance	Typical Input C	Linear Range	Max Voltage DC + pk AC	Tip/Head Style
Active Probes									
P6201	1.8 m	1	900 MHz	±5.6 V	100 kΩ	3.0 pF	±0.6 V	±100 V	
		10	900 MHz	±56 V	1 MΩ	1.5 pF	±6.0 V	±200 V	
		100	900 MHz	±200 V	1 MΩ	1.5 pF	±60 V	±200 V	
P6202A	2.0 m	10	500 MHz	±55 V	10 MΩ	2.0 pF	+6.0 V	±200 V	
		100	500 MHz	±200 V	10 MΩ	2.0 pF	±60 V	±200 V	
P6203	1.5 m	10	1000 MHz	±10 V	10 kΩ	2.0 pF	±10 V	±40 V	Min.
P6204	1.5 m	10	1000 MHz	±15 V	10 MΩ	1.9 pF	±10 V	±40 V	Min.
P6205	1.5 m	10	750 MHz	N/A	1 MΩ	2.0 pF	±10 V	±40 V	Min.
P6206	1.6 m	10	1000 MHz	N/A	1 MΩ	2.0 pF	±10 V	±40 V	Min.
P6207	1.6 m	10	4000 MHz	±5 V	100 kΩ	0.4 pF	±4.0 V	±40 V	4 mm
P6217	1.5 m	10	4000 MHz	±5 V	100 kΩ	0.4 pF	±4.0 V	±40 V	4 mm
P6231	1.5 m	10	1500 MHz	±5 V	450 Ω	1.6 pF	±5.0 V	±30 V	Sub.

Type	Length	Attenuation	Bandwidth at –3dB	Instrument Input	System Input Resistance	Typical Input C	Gnd Ref	Read Out	ID	Max Voltage DC + pk AC	Tip/Head Style
50 Ω Divider Probes											
P6150	1 m	10	9GHz	50 Ω	500 Ω	<0.15 pF				12.5 Vrms *1	Comp
		1	≥3 GHz	50 Ω	50 Ω	N/A					
P6156	1.5 m	10	≥3.5 GHz	50/1 MΩ	500 Ω	≤1 pF		√	√	15 Vrms	Comp
Opt. 25		100	≥3.0 GHz	50/1 MΩ	5000 Ω	≤1.1 pF		√		50 Vrms	
		20	≥3.5 GHz	50/1 MΩ	1000 Ω	≤1 pF		√		22 Vrms	
		1	≥1.5 GHz	50/1 MΩ	50 Ω	N/A		√		*2	

m = meters V = volts MHz = Megahertz MΩ = Mega Ohms pF = picofarads

**1 Limited by scope input or 42 Vrms.*
**2 Limited by scope input or 50 Vrms.*

Active Probes

Choosing an Active Probe

Active performance with passive simplicity.

DESIGNED FOR:

- Digital Design and Debug of Logic Families such as:
  - –ECL
  - –GaAs
  - –CMOS
  - –TTL
- Component Characterization/ Measurement of High-Speed Analog Circuitry Relative to:
  - –Amplitude Levels
  - –Aberrations
  - –Propagation Delay and Timing
  - –Bandwidths and Rise Times

Today active probes achieve higher performance than their predecessors and their high impedance passive counterparts. They provide:

Easy Use:

- **Integral Probe Power** from compatible instrumentation.
- **Scope AutoCal**[*1] which compensates for probe offsets and drift.
- **Readout Encoding** accounts for probe attenuation factor and reduces measurement reading errors.
- **Auto Termination** eliminates the need to manually terminate the system. (TEKPROBE models).
- **Wide Linear Dynamic Range** allows access to today's logic voltage levels.
- **Variable DC Offset** allows correction for DC levels, to bring the signal into the probe's linear dynamic range. Probe Offset is controlled by a compatible instrument, externally by the probe itself or, for the P6205 and P6206 models, there are no probe offset controls to deal with.

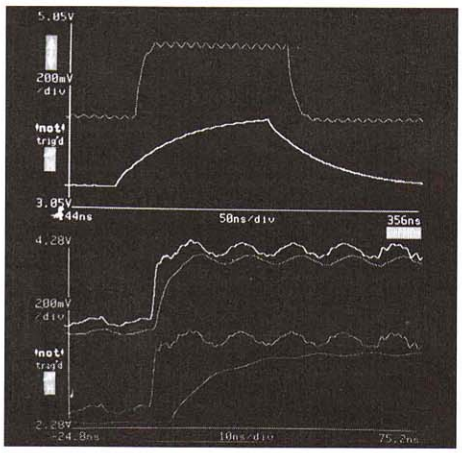
Truer Signal Reproduction and Fidelity

- **Ultra-Low Input Capacitances and High Input Resistances** allow making measurements at unknown impedance test points by maintaining higher probe input impedance across a wider bandpass and reduce ground lead loop effects allowing the use of longer ground leads than a standard passive probe.
- **DC up to 4 GHz Bandwidths** allow improved AC and DC signal characterization and testing.

Service, Durability and Reliability

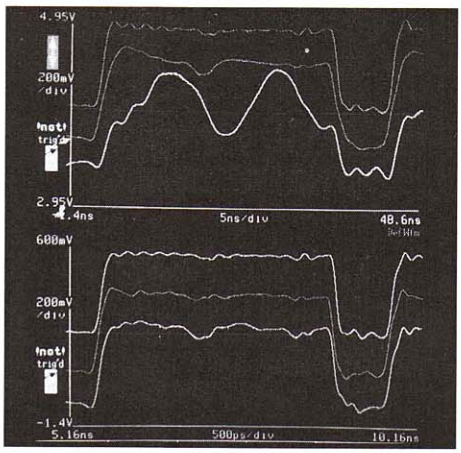
- **1 Year Warranty**.
- **Gold Plated Replaceable Probe Tips** (except P6207/P6217) improve electrical connections, reliability and lower maintenance costs.

*[*1] 11000 Series Only*



The waveforms above show impedance points of 50 Ω and 1 kΩ as probed with:

- *A 1X Passive probe [trace T1 (50 Ω), trace T2 (1 kΩ)],*
- *A 10X Active FET probe [trace T3 (50 Ω), trace T4 (1 kΩ)] and*
- *A 10X Passive probe [trace T5 (50 Ω), trace T6 (1 kΩ)].*



The waveforms above show the effects of ground lead inductance. The top three traces show how the displayed waveform changes as the passive probe's ground lead length is increased from 1/2 in. (top trace) to 6 in. to 12 in. (bottom trace). The bottom three traces show how an Active probe's waveform remains relatively unchanged regardless of ground lead length using the same ground lead sequence as the passive probe in the top three traces.

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

Active Probes
Choosing an Active Probe

CHOOSING AN ACTIVE PROBE

WHERE or WHEN YOU HAVE	WHAT YOU NEED	WHY
Source impedance test points; >100 Ω and/or low power circuits	Any active probe with greater than 100 kΩ and <2 pF; depends on the instrumentation interface, the frequency range and the sensitivity required.	Active probes maintain a higher input impedance throughout their frequency range. The low input C and high input R combination, allow the acquisition of the fastest rise times (input C influenced), accurate amplitude measurements and provide less signal drain than a conventional passive probe.
Small signal circuit analysis	P6201 with its 1X sensitivity or P6217, P6204 and P6205 with 11K high resolution mode.	Unity gain (1X) allows full sensitivity without bandwidth loss and maintains signal amplitude of small signals.
Characterization of circuits >350 MHz	The use of active probes or 50 Ω divider probes is recommended, depends upon the frequency and measurement response required.	Low input C, 50 Ω divider probes provide excellent rise time and propagation delay measurements. However active probes provide better over all circuit analysis capabilities (amplitudes, rise times, propagation delay,aberrations,etc.).
Tuned Circuits: Oscillators, tank circuits, etc.	P6217, P6207, P6201, P6204 dependent upon the frequency and measurement response required.	Low input C and high input R minimize circuit disturbance by reducing any additional impedance to the circuit.
General purpose circuit characterization and trouble-shooting where the circuit under test impedance is unknown or not easily calculated and/or access to circuit ground is several inches away.	The P6205 or P6206 active probes provide low input C, high input R, durability and a budget price.	Low input C and the high input R provide truer signal fidelity for unknown or uncalculated impedance points. Lower input C's also provide a higher ring frequency than passive probes allowing the use of longer grounds.

Probe Type	Cable Length in meters	Atten-uation	Band-width at –3dB in MHz	Input C in ≤pF	Input R in Ω	Linear Dynamic Range in Volts	DC Offset Range in Volts	Maximum Voltage in Volts (DC + pk AC)	Interface/ Readout/ Identify*2	Recommended Instrument
P6201	1.8	1X 10X 100X	900 900 900	3 1.5 1.5	100 k 1 M 1 M	±0.6 ±6.0 ±60	±5.6 ±56 ±200	±100 ±200 ±200	BNC/Y/N BNC/Y/N BNC/Y/N	400 / 2400 / 7000 Series*3
P6202A *1	2	10X 100X	500 500	2 2	10 M 10 M	±6.0 ±60	±55 ±200	±200 ±200	BNC/Y/N BNC/N/N	400 / 2400 / 7000 Series *3
P6203	1.5	10X	1000	2	10 k	±10	±10	±40	TPB/Y/Y	11000 *4
P6204	1.5	10X	1000	1.9	10 M	±10	±15	±40	TPB/Y/Y	11000 *4 TDS400/ 500/600*5
P6205	1.5	10X	750	2	1 M	±10	NA	±40	TPB/Y/N	11000 *4 TDS400/ 500/600*5
P6217	1.5	10X	4000	0.4 (typical)	100 k	±4.0	±5.0	±40	TPB/Y/N	11000 *4 TDS400/ 500/600*5
P6231	1.5	10X	1500	1.6	450	±5.0	±5.0	±30	TPB/Y/Y	11000 *4
P6206	1.6	10X	1000	2	1 M	±10	NA	±40	TPS/Y/N	TDS800
P6207	1.6	10X	4000	0.4 (typical)	100 k	±4.0	±5.0	±40	TPS/Y/N	TDS800

**1 Optional Accessory. Order 010-0384-00.*
**2 Interface / Readout / Identify-AutoProbe Code: TPB=TEKPROBE BNC / TPS=TEKPROBE SMA/BNC=Conventional BNC / Y=Yes / N=No.*
**3 Requires Probe Power connector on the scope or recommended power supply.*
**4 11000 Series = 11A32 / 11A34 / 11A52 / 11A71 / 11A81 in a compatible mainframe, i.e., DSA600 / CSA400 / 11400 / Etc.*
**5 P6204 and P6217 DC Offset Functions are not incorporated into the TDS400 / 500 / 600 Families.*

P6207
P6206

Active FET Probes
For TEKPROBE SMA Interfaces

High Performance Active Probes for the TDS 800 Series Oscilloscopes.

P6207/P6206

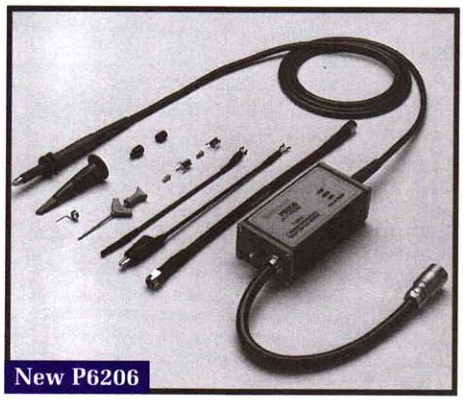
- True Signal Fidelity
  - DC up to 4 GHz
- Ultra-Low Input Capacitance
  - 0.4 pF Provides Lower Circuit Loading and the use of longer ground leads
- High Input Resistance 1 MΩ
  - Maintains Circuit Biasing Levels
- Easy to Use
  - Active Performance with Passive Simplicity
- Variable DC Offset ±5 V
- Integral Probe Power TEKPROBE SMA
- Small Geometry Accessibility

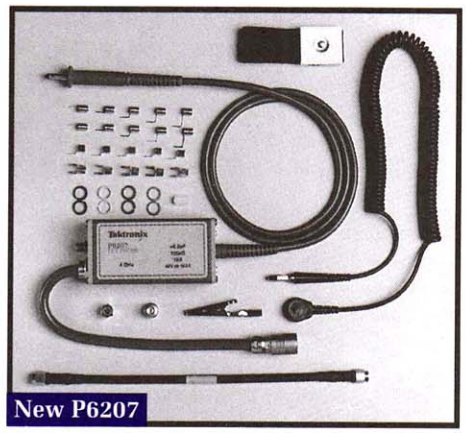
P6207

- DC to 4 GHz
- 0.4 pF Input C
- 100 kΩ Input R
- DC Offset
- Small Size

P6206

- DC to 1 GHz
- 2 pF Input C
- 1 MΩ Input R
- Small Size


New P6206


New P6207

The NEW P6206 and NEW P6207 Active (FET) Probes are Tektronix' line of Low Circuit Loading Signal Acquisition probes for TDS800 Series Family of Oscilloscopes.

The P6207 provides the widest bandwidth and lowest input capacitance at 100 kΩ available for a hand-held active voltage probe.

The P6206 provides wide bandwidth, with low input capacitance and high input resistance.

Both probes provide a wide linear dynamic input range for accessing most digital device families using today's logic voltage levels.

The reduced input capacitance for these active FET probes reduces the AC current flow and reduces the sensitivity to the ground loop, thereby easing ground lead length requirements.

The P6207 provides a variable DC Offset function which is controlled through the TDS800 Series mainframe to bring signals (those within the offset control range) into the dynamic range of the probe.

Probe information such as: type; serial number; attenuation factor; offset scale factor; input resistance; and termination resistance required, is communicated through the TEKPROBE™ SMA Interface between the Active Probe and the TDS 800 Series mainframe. This information is used by the oscilloscope mainframe during the scope initialization sequence and measurement analysis.

Power for the P6206 and P6207 is supplied by the TDS 800 Series mainframes through the TEKPROBE™ SMA Interface, eliminating the need for extra cabling and/or external power supplies.

BENEFIT HIGHLIGHTS

- **Low Input C, High Input R –** Minimizes circuit under test loading
- **Probe Power Directly from TDS800 Series TEKPROBE™ SMA Interfaces –** Means no additional cables or power supplies required
- **Variable DC Offset (Except P6206) –** Allows correction for DC levels to bring the signal into the probe's dynamic measurement range
- **Readout Coding for 10X Attenuation –** Reduces confusion and errors in measurement readings
- **Gold Plated Replaceable Probe Tips (Except P6207) –** Improved electrical connections and lower maintenance costs
- **Miniature Size Accessories Compatible (Except P6207) –** Provides wide range of circuit attachments
- **U.L. Listed –** Third party certification for safe operation

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

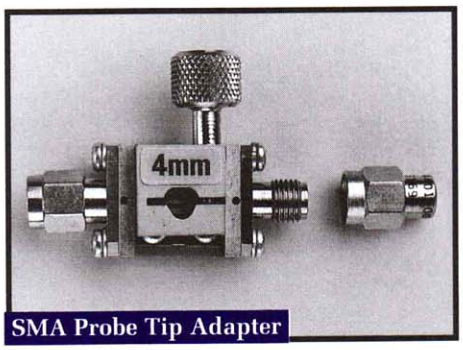
Active FET Probes
For TEKPROBE SMA Interfaces

P6207
P6206

PROBE TIP ADAPTER

The Probe Tip Adapter is a high-performance 50 Ω 'T' type pickoff for use with high impedance Tektronix P6207 or P6217 Active FET probes, the Tektronix SD-14 Sampling Head and other probes compatible with the 4 mm probe tip system. The in-line portion of the "T" is fitted with SMA-compatible 2.92 mm connector, one end male and one end female. The signal pickoff point is a receptacle for the Probe Tip. An SMA male 50 Ω termination is included.

When used with the P6207 or P6217 the Probe Tip Adapter allows signal pickoff from a 50 Ω system with a minimum of disturbance of the system characteristics. This provides a convenient means of obtaining a signal for the P6207 or P6217 from a closed coaxial 50 Ω system.



SMA Probe Tip Adapter

DESIGNED FOR:

- Digital Design and Debug of Logic Families such as:
  - –ECL
  - –GaAs
  - –CMOS
  - –TTL
- Component Characterization/ Measurement of High-Speed Analog Circuitry Relative to:
  - –Amplitude Levels
  - –Aberrations
  - –Propagation Delay and Timing
  - –Bandwidths and Rise Times

CHARACTERISTICS

Probe Type	Nominal Cable Length in meters	Atten-uation	Band-width at -3dB in MHz	Input C in pF	Input R in Ω	Linear Dynamic Range in Volts	DC Offset Range in Volts	Maximum Voltage in Volts (DC + pk AC)	Interface/ Readout/ Identify*1	Recommended Instrument
P6206	1.6	10X	1000	2	1 M	±10	N/A	±40	TPS/Y/N	TDS800
P6207	1.6	10X	4000	0.4 Typical	100 k	±4.0	±5.0	±40	TPS/Y/N	TDS800

*1 *Interface / Readout / Identify-AutoProbe Code: TPB=TEKPROBE BNC / TPS=TEKPROBE SMA / BNC=Conventional BNC / Y=Yes / N=No.*

ORDERING INFORMATION

P6207
4 GHz Active FET Probe, SMA **$3,495**
Includes: 1 RF Cable Assembly, 8.5 in. (174-1120-00); 4-post ECB mount ground socket (151-5308-00); Edge Tab Ground Socket (131-5309-00); 2 Each of 5 Lengths Wire-Form Ground (131-5482-00); 1 Electrostatic Protection Cap (200-3961-00); 1 SMA Shorting Connector (015-1021-00); 1 Adjustable Anti-Static Wrist Strap (006-3415-04); Storage Cabinet; Instruction Manual (070-7909-00)

P6206
1 GHz Active Probe, SMA **$1,495**
Includes: 1 RF Cable Assembly, 8.5 in. (174-1120-00); 1 Ground Lead, 6 in. w/alligator clip (196-3120-00); 1 SMT KlipChip (206-0364-00): 1 Ground Cover (166-0404-01); 1 Ground Lead, 6 in. w/square pin receptacle (198-3198-00); 1 Retractable Hook Tip (013-0107-07); 1 Ground Contact, spring (214-4125-00); carrying case; Instruction Manual (070-8572-00) Probe Tip Adapter – Order (013-0271-00).

P6207 RECOMMENDED ACCESSORIES
Probe Tip Adapter – For P6207, P6217, SD-14. Active probes. Instruction sheet plus SMA Male 50Ω termination provided (015-1022-00). Order 013-0271-00 ..... **$495**

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

P6217
P6205
P6204

P6203
P6231

Active FET Probes

For TEKPROBE BNC Interfaces

Easy to Use, Active Performance, Passive Simplicity.

P6217/P6205/P6204/ P6203/P6231

- Ultra Low Input Capacitance
- High Input Resistance
- True Signal Fidelity up to 4 GHz
- Variable DC Offset
- Integral Probe Power TEKPROBE BNC

P6217

- DC to 4 GHz
- ≤0.40 pF Input C
- 100 kΩ Input R
- DC Offset
- Small Size

P6205

- DC to 750 MHz
- 2 pF Input C
- 1 MΩ Input R
- Small Size

P6204

- DC to 1 GHz
- 1.9 pF Input C
- 10 MΩ Input R
- DC Offset
- Identify Button

P6203

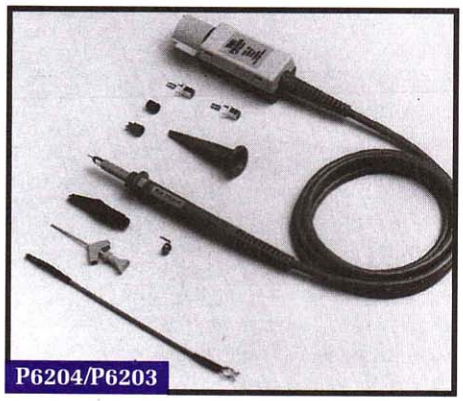
- DC to 1 GHz
- 2 pF Input C
- 10 kΩ Input R
- DC Offset
- Identify Button

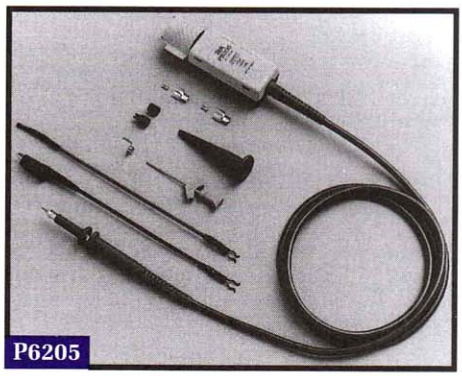
P6231

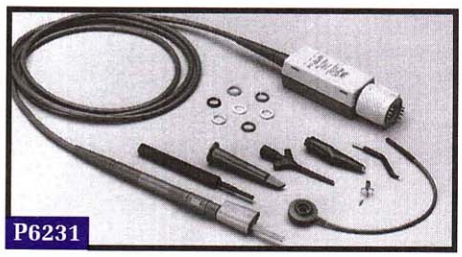
- DC to 1.5 GHz
- 1.6 pF Input C
- 450 Ω Input R
- Bias/Offset (Tip Nulling)
- Small Size

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

New P6217


P6204/P6203


P6205


P6231

The P6203, P6204, P6205, New P6217 and P6231 Probes are Tektronix's line of Low Circuit Loading Signal Acquisition probes for CSA (Communications Signal Analyzers), DSA (Digitizing Signal Analyzers), 11000 Series and the TDS Family of Oscilloscopes.

The P6204, P6205 and P6217 are designed with FET devices for their inputs which allows very high input resistance values and low input capacitances.

The P6203 and P6231 are specialty active probes in that the P6203 uses Bipolar technology to achieve a low input capacitance while attaining a mid-level input resistance. The P6231 on the other hand provides a higher impedance level to DC through an Bias/Offset capability which provides an adjustable tip nulling voltage.

The P6217 provides the widest bandwidth and lowest input capacitance at 100 kΩ available for a hand-held active voltage probe.

The P6204 provides wide bandwidth, with low input capacitance and the highest input resistance available. At the same time the P6204 is the only active FET probe available which provides remote control capabilities.

The P6205 provides low input capacitance and high input resistance performance at a budget price.

All three Active FET probes provide a wide linear dynamic input range for accessing most digital device families using today's logic voltage levels.

Power for the P6203, P6204, P6205, P6217 and P6231's is supplied by the CSA, DSA, TDS and 11000 Series mainframes through the TEKPROBE™ BNC Interface, eliminating the need for extra cabling and/or external power supplies*[1].

A variable DC Offset function which is controlled through the mainframe (CSA, DSA and 11000 series) to bring signals (those within the offset control range) into the dynamic range of the probe is available for the P6203, P6204 and P6217 probes.

The P6231 Bias/Offset probe acts as a standard 500 Ω passive divider voltage with the additional capability of having an adjustable tip nulling voltage. This feature reduces the DC-Loading effects of the probe when it is used to measure signals whose mid-voltage value is not at zero volts, or in circuits where the termination impedance is not returned to ground level. The Input Bias/Offset Voltage may be adjusted so that the voltage at the probe input resistor is equal to the test signal potential: thus no DC current flows through the probes input resistor.

Active FET Probes

For TEKPROBE BNC Interfaces

P6217 **P6203**
P6205 **P6231**
P6204

Probe information such as: type; serial number; attenuation factor; offset scale factor; input resistance; and termination resistance required, is communicated through the TEKPROBE™ Interface between the Active Probe and the CSA, DSA and 11000 Series mainframes. This information is used by these oscilloscope mainframes during the scope initialization sequence and measurement analysis.

Remote Control of several 11000 Series Programmable Functions/Actions is possible using the "Identify Button" on the P6203, P6204 and P6231 probe head.

These functions are selectable via the 11000 Series mainframe Utility Menus and include: Autoset; recall the next in a series of stored setups; invoke Automatic-Measurement; issue an SRQ (service action request); or activate the trace identification function.

Although designed for the CSA, DSA, TDS and 11000 Series Oscilloscopes, these Active Probes may also be used with 50 Ω or 1 MΩ oscilloscope systems, with conventional BNC interfaces, via the Tektronix 1103 TEKPROBE™ Power Supply. The 1103 can power up to two TEKPROBE™ probes*[2].

BENEFIT HIGHLIGHTS

- **Low Input C, High Input R –** Minimizes circuit under test loading.
- **Probe Power Directly from CSA,DSA,TDS or 11000 Series TEKPROBE™ SMA Interfaces –** Means no additional cables or power supplies required[1].
- **Variable DC Offset (Except P6205/P6231) –** Allows correction for DC levels to bring the signal into the probe's dynamic measurement range.
- **Readout Coding for 10X Attenuation –** Reduces confusion and errors in measurement readings.
- **Gold Plated Replaceable Probe Tips (Except P6217) –** Improved electrical connections and lower maintenance costs.
- **Miniature Size Accessories (Except P6217/ P6231) –** Provides wide range of circuit attachments.
- **U.L. Listed –** Third party certification for safe operation.

DESIGNED FOR:

- Digital Design and Debug of Logic Families such as:
  - –ECL
  - –GaAs
  - –CMOS
  - –TTL
- Component Characterization/ Measurement of High-Speed Analog Circuitry Relative to:
  - –Amplitude Levels
  - –Aberrations
  - –Propagation Delay and Timing
  - –Bandwidths and Rise Times

[1] To use these TEKPROBE BNC Interface Probes on the 11800 or CSA800 Series, requires a 1103 TEKPROBE™ Power Supply, an SMA Male to BNC Female adapter, and a 50 Ω BNC cable.

[2] For 50 Ω and 1 MΩ BNC inputs a 50 Ω BNC cable is required. 1 MΩ inputs also require a 50 Ω feed-through terminator.

CHARACTERISTICS

Probe Type	Nominal Cable Length in meters	Attenuation	Bandwidth at -3dB in MHz	Input C in pF	Input R in Ω	Linear Dynamic Range in Volts	DC Offset Range in Volts	Max. Voltage in Volts (DC + pk AC)	Interface/ Readout/ Identify*1	Recommended Instrument
P6203	1.5	10X	1000	2	10 k	±10	±10	±40	TPB/Y/Y	11000 *2
P6204	1.5	10X	1000	1.9	10 M	±10	±15	±40	TPB/Y/Y	11000 *2
P6205	1.5	10X	750	2	1 M	±10	NA	±40	TPB/Y/N	TDS400/500/600
P6217	1.5	10X	4000	0.40 Typical	100 k	±4.0	±5.0	±40	TPB/Y/N	11000 *2 TDS500/600*3
P6231	1.5	10X	1500	1.6	450	±5.0	±5.0	±30	TPB/Y/Y	11000 *2

**1 Interface / Readout / Identify Code: TPB=TEKPROBE "BNC" / TPS=TEKPROBE "SMA" / BNC=CONVENTIONAL "BNC" / Y=Yes / N=No*
**2 11000 SERIES = 11A32/11A34/11A52/11A71/11A72/11A81*
**3 P6204 and P6217 DC Offset functions are not incorporated into the TDS400/500/600 Families*

ORDERING INFORMATION

P6203
10X, 1 GHz Bipolar Probe **$1,200**
Includes: Retractable Hook Tip (013-0107-07); 6 in Ground Lead w/Alligator (196-3120-00); 6 in Ground Lead w/Square Pin Receptacle (196-3198-00); Ground Contact, Spring (214-4125-00) SMT KlipChip™ (206-0364-00); Insulating Ground Cover (166-0404-01); IC Test Tip; 2 Probe Tip to Circuit Board Adapters; Carrying Case; Instruction Manual (070-6823-00).

P6204
10X, 1 GHz Active FET Probe **$1,495**
Includes: Same as P6203 Except Instruction Manual (070-6949-00).

P6205
10X, 750 MHz Active FET Probe **$495**
Includes: Same as P6203 Except Instruction Manual (070-8202-00).

P6217
4 GHz Active FET Probe **$3,495**
Includes: 4-post ECB mount ground socket (151-5308-00); Edge Tab Ground Socket (131-5309-00); 2 Each of 5 Lengths Wire-Form Ground (131-5482-00); 1 Electrostatic Protection Cap (200-3961-00); 1 Adjustable Anti-Static Wrist Strap (006-3415-04); Storage Cabinet; Instruction Manual (070-8553-00).

P6231
10X, 1.5 GHz Bias/Offset Probe **$650**
Includes: Retractable probe tip (013-0208-02); Probe Tip-to-Circuit Board Connector (131-2766-03); 6 in Ground Lead w/Alligator (196-3305-00); 6 in Ground Lead w/Square Pin Receptacle (196-3113-02); 2 in Ground Lead (195-4240-00); SMT KlipChip™ (206-0364-00); Probe Adjustment Tool (003-1433-00); Probe Holder (352-0351-00); Cable Markers, 2 Each of 4 Colors; Carrying Case; Instruction Manual (070-6027-00).

ADDITIONAL ACCESSORIES
Probe Tip Adapter – For P6207, P6217 and SD-14 Active Probes Instruction Sheet Plus SMA Male 50 Ω Termination provided. Order 013-0271-00 ..... **$495**

1103
TEKPROBE™ Power Supply **$495**
For P6203, P6204, P6205. P6231 and P6217. Powers 2 Probes (See Page 438).

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

P6201
P6202A

Active FET Probes

For 50 Ω and 1 MΩ Interfaces

Large and Small Signal Measurements while Maintaining Low Capacitive Loading

P6201/ P6202A

- True Signal Fidelity, DC up to 900 MHz
- Low Input Capacitance, < 1.5 pF
- High Input Resistance10 MΩ
- Variable DC Offset, Up to ±200 V
- Selectable 50 Ω, Termination For Use with 50 Ω or 1 MΩ Inputs

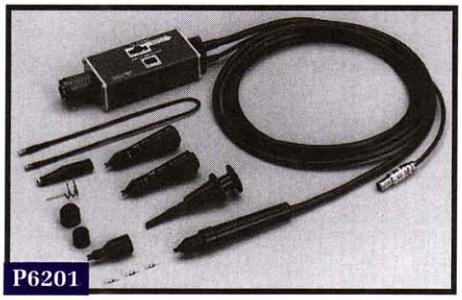
P6201

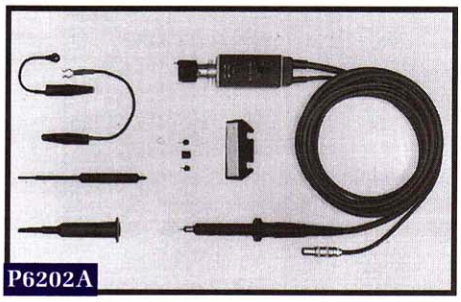
- DC to 900 MHz
- 1.5 pF Input C*
- 1 MΩ Input R*
- Unity Gain
- 1X/10X/100X
- DC Offset
- AC-DC Coupling

P6202A

- DC to 500 MHz
- 2 pF Input C
- 10 M Ω Input R
- 10X/Optional 100X
- DC Offset
- AC-DC Coupling

** See Specifications*


P6201


P6202A

The P6201 and P6202A are Tektronix's line of Low Circuit Loading Active Signal Acquisition probes for 400 Series, 2400 Series, and 7000 Series Families of Oscilloscopes.

The P6201 and P6202A with Active FET devices in their inputs provide very high input impedances.

Both the P6201 and P6202A probes provide a wide linear dynamic input range for accessing most digital device families using today's logic voltage levels.

The P6201 provides unity gain and is the best general purpose FET probe within its voltage range. Plug-on attenuator heads provide wider dynamic ranges (10X and 100X) while maintaining the oscilloscope readout factor.

Wider dynamic input range for the P6202A is achieved by an optional 10X attenuator head which provides 100X attenuation.

Both the P6201 and P6202A probes provide a variable DC Offset function which is controlled via the offset controls on the probe's compensation box to bring signals (those within the offset control range) into the dynamic range of the probe.

AC or DC coupling selection is available on the P6201 and P6202A FET Probes. When AC coupled, the DC voltage component is blocked allowing viewing of super-imposed signals.

A self contained selectable 50 Ω termination switch allows the P6201 or P6202A to be terminated into a 50 Ω or 1 MΩ oscilloscope inputs.

Power for the P6201 and P6202A is supplied by the 400 Series, 2400 Series, and 7000 Series mainframes through the optional Probe Power Jack, or the 1101A Power Supply.

The P6201 or P6202A may also be used with other 50 Ω and 1 MΩ input real time oscilloscopes, sampling systems, spectrum analyzers and counters via the 1101A and appropriate interface adapters (SMA to BNC, GR to BNC, etc).

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

Active FET Probes

For 50 Ω and 1 MΩ Interfaces

P6201
P6202A

P6201, P6202A, 1101A

DESIGNED FOR:

- Digital Design and Debug of Logic Families such as:
  - –ECL
  - –GaAs
  - –CMOS
  - –TTL
- Component Characterization/ Measurement of High-Speed Analog Circuitry Relative to:
  - –Amplitude Levels
  - –Aberrations
  - –Propagation Delay and Timing
  - –Bandwidths and Rise Times

CHARACTERISTICS

Probe Type	Nominal Cable Length in meters	Atten-uation	Band-width at -3dB in MHz	Input C in pF	Input R in Ω	Linear Dynamic Range in Volts	DC Offset Range in Volts	Maximum Voltage in Volts (DC + pk AC)	Interface/ Readout/ Identify*1	Recommended Instrument
P6201	1.8	1X	900	3	100 k	±0.6	±5.6	±100	BNC/Y/N	400 / 2400 / 7000 series *2
		10X	900	1.5	1 M	±0.6	±5.6	±200	BNC/Y/N	
		100X	900	1.5	1 M	±0.6	±200	±200	BNC/Y/N	
P6202A *3	2	10X	500	2	10 M	±6.0	±55	±200	BNC/Y/N	400 / 2400 / 7000 series *2
		100X	500	2	10 M	±6.0	±200	±200	BNC/Y/N	

**1 Interface / Readout / Identify-AutoProbe Code: TPB=TEKPROBE BNC / TPS=TEKPROBE SMA/BNC=Conventional BNC / Y=Yes / N=No.*

**2 Requires ProbePower connector on mainframe or 1101A Power Supply.*

**3 Optional Accessory. Order 010-0384-00.*

ORDERING INFORMATION

P6201
1X, 900 MHz FET Probe **$1,495**
Includes: Retractable Probe Tip (013-0135-00); 10X Attenuator Head (010-0376-00); 100X Attenuator Head (010-0377-00); 3 Probe tips (206-0200-00); Miniature Probe Tip Adapter (103-0164-00); 12 in. Ground Lead (175-0848-02); Ground Contact (131-1302-00); Alligator Clip (344-0046-00); Electrical Insulating Sleeve (166-0577-00); Ground Contact Insulator (342-0180-00); Probe Holder (352-0351-00); Carrying Case; Instruction Manual (070-1306-00).

P6202A
10X, 500 MHz FET Probe **$995**
Includes: Retractable Probe Tip (013-0097-01); 2 Alligator Clips (344-0046-00); Probe Holder (352-0351-00); 3 in. Ground Lead (175-0849-00); Probe Adjustment Tool (003-0675-01); 6 in. Ground Lead (175-1017-00); 2 Replaceable Probe Tips (206-0230-00); Electrical Insulating Sleeve (166-0404-01); Carrying Case; Instruction Manual (070-3642-00).

ADDITIONAL ACCESSORIES
Also see pages 472-483.

10X Attenuator – (P6202A only) For a total of 100X attenuation. Order 010-0384-00 ..... **$120**

AC Coupling Capacitor – (P6202A only) Order 010-0360-00 ..... **$50**

1101A Power Supply – (See Page 438)
For P6201, P6202A Powers 2 Probes **$525**

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

P6150
P6156

Low Capacitance
Low Impedance Zo TDR Passive Probes

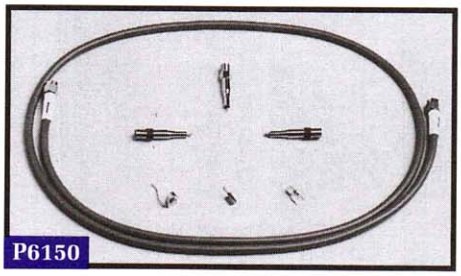
50 Ω divider probes for high speed edge measurements and propagation delays.

P6150
- 9 GHZ

P6156
- 3.5 GHz Compact Tip

TYPICAL APPLICATIONS
- High Speed Device Characterization in Microwave Communication, Signal Processing, and Logic Applications
- Propagation Delays for ECL, GaAs and Other Logic Circuitry and Devices
- Circuit Board Impedance Testing (TDR)

FEATURES/BENEFITS
- Low Capacitive Loading to Extremely High Frequencies
- Interchangeable Attenuator Tip Assemblies, 1X and 10X (20X and 100X P6156 only)



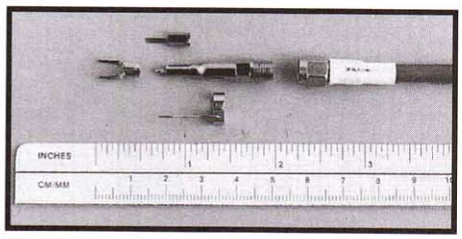
Sampling

Two characteristics are essential in a system for sampling repetitive high frequency signals: high bandwidth and low input capacitance. Tektronix' low impedance Zo passive voltage probes give you both – without the added cost of an active probe. However, if you need low resistive loading, you should choose one of the active probes on page 320.

With bandwidths of up to 9 GHz on the P6150 and 3.5 GHz on the P6156, these probes get you as close as possible to your scope's maximum bandwidth. Accurate risetime and propagation delay readings are possible with less than 0.15 pF Input C (less than 1.0 pF with the P6156).

1X ATTENUATOR FOR TDR

With 1X attenuation available, these probes are also a quick and easy solution to circuit board impedance testing of Time Domain Reflectometry (TDR) without the hassles of soldering or fixturing.



P6150 Typical Accessories

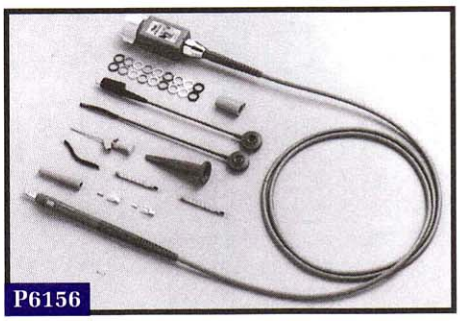
P6150 DC TO 9 GHZ
- 10X Attenuating Probe, Low Impedance Zo with 1X Accessory Tip
- Small Size
- Ideal for 50 Ω Environments
- Interchangeable Probe Tips (1X, 10X)
- Recommended Probe for 11800/CSA800 SD2X/7000 Family Sampling Plug-Ins
- SMA Cable Connectors for Optimum Signal Integrity
- High Quality, Flexible Probe Cable

The P6150 is a very high bandwidth, 10X attenuation, low impedance probe designed for use with the SD2X family of Sampling/TDR plug-ins. The probe consists of interchangable, screw in attenuator tip assemblies (1X and 10X) and a SMA-to-SMA probe cable. An assortment of circuit and grounding attachments are included to optimize attachment to the device under test, while maintaining high signal integrity.

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

Low Capacitance
(Low Impedance Zo)
TDR Passive Probes

P6150
P6156



P6156 DC TO 3.5 GHZ
- 10X Attenuating, Low Impedance Zo Probe, with Identify and Readout.
- Interchangeable Probe Tips 1X, 10X, 20X, 100X.

The P6156 is a 3.5 GHz, low impedance Zo probe (50 Ω divider) which comes standard with a 10X (500 Ω) attenuator tip. The 100X attenuation value is available as an option and the 1X and 20X attenuators may be purchased as replaceable subassemblies. Although designed for the 11A52, 11A72, and 11A82, the P6156 probe may be used with 11000-Series plug-ins, the 11800-Series SD2X Sampling/TDR plug-ins, 7000-Series plug-ins and Sampling/TDR units, 2400 Series, or other 50 Ω/1 MΩ input channel amplifiers and oscilloscopes (with the proper adapters).

The 50 Ω Termination required by the P6150 is automatically sensed by 1100-Series mainframes and plug-ins.The P6156 may be directly connected to a 50 Ω input, but requires a 50 Ω termination when used with 1 MΩ amplifiers. Check the instruction sheet for proper usage. This probe gives you a handy identify button for accessing many of the functions of your 11000 or DSA600 Series scopes from the probe. The compact tip size is perfect for accessing small geometry circuits. The attenuator tips are color-coded to a switch on the compensation box of the P6156 to help in properly setting the readout scale factor.

Note: The P6156 attenuator tip must be changed and the compensation box readout switch changed to provide the various 1X, 10X, 20X, and 100X attenuation values. Tip colors match switch setting colors.

CHARACTERISTICS

Probe Type	Nominal Length	Attenuation	Bandwidth	Rise Time	Loading Input R/C	Max V In	Instrument Input R/C	Propagation Delay Identify	Interface/ Readout/ Identify
P6150	1 m	10X ±2%	9 GHz	<38.8 ps	500 Ω/<0.15 pF	12.5 V rms	50 Ω	4.40 ns ±0.1 ns	S/N/N
		1X ±2%	≥3 GHz	≤170 ps	50 Ω/N/A	*1	50 Ω	4.40 ns ±0.1 ns	S/N/N
P6156	1.5 m	10X ±3%	≥3.5 GHz	<100 ps	500 Ω/≤1 pF	15 V rms	50 Ω/1 MΩ	7.75 ns ±0.07 ns	B/Y/Y
		100X ±3%	≥3.0 GHz	≤120 ps	5000 Ω/≤1.1 pF (Typically 1 pF)	50 V rms	50 Ω/1 MΩ	7.75 ns ±0.07 ns	B/Y/Y
		20X ±3%	≥3.5 GHz	<100 ps	1000 Ω/≤1 pF	22 V rms	50 Ω/1 MΩ	7.75 ns ±0.07 ns	B/Y/Y
		1X ±5%	≥1.5 GHz	<300 ps	50 Ω/N/A	*2	50 Ω/1 MΩ	7.75 ns ±0.07 ns	B/Y/Y

Interface/Readout/Identify: Interface: B=BNC; S=SMA
Readout/Identify: Y=Yes; N=No
**1 Limited by scope input or 42 V rms.*
**2 Limited by scope input or 50 V rms.*

ORDERING INFORMATION

P6150
10X, 9 GHz, 1.0 m, Low Impedance Probe **$995**
Includes: One 1X attenuator head (206-0398-00); Two 10X attenuator heads (206-0399-02); 1.0 m Cable assembly (174-1341-00); Instruction sheet (070-7173-00); and 1 Accessory kit consisting of: 20 each ground clip, 3 each adjustable ground lead, 10 each electrical contact, and 2 each probe to circuit board ground connectors (020-1708-00)

ADDITIONAL ACCESSORIES
Also see pages 472-483.
SMA to Probe Tip Adapter – Order 013-0251-01 ..... *1

P6156
3.5 GHz (10X), 1.5 m Low Impedance Probe **$265**
Includes: 10X Attenuator head (206-0380-00), 6 in. ground lead w/alligator clip (196-3305-00) Retractable hook tip (013-0107-07); 2 Circuit board connectors; 2 in. Ground lead (195-4240-00); 6 in. Ground lead (196-3113-02); Ground collar (343-1003-01); SMT KlipChip™ (206-0364-00); 2 each cable markers various colors: gray, white, green, red: Probe tip holder (352-0670-00); Instruction sheet (070-6430-00).
Opt. 25 – Adds 100X Attenuator ..... **+$60**

ADDITIONAL ACCESSORIES
Also see pages 472-483.
SMA Male to BNC Female – Order 015-0554-00 ..... **$41**
SMA Female to BNC Male – Order 015-0572-00 ..... **$24**
SMA to Probe Tip – Order 013-0237-00 ..... **$345**
Probe Tips – For P6156 only
(1X) Order 206-0379-00 ..... **$65**
(10X) Order 206-0380-00 ..... **$65**
(20X) Order 206-0381-00 ..... **$65**
(100X) Order 206-0382-00 ..... **$80**

**1 Please contact you local Tektronix representative for price and ordering information.*

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

1101A 1102 1103

Probe Power Supply

External Probe Power... For Instrumentation Without Capability to Provide Probe Power

1101A

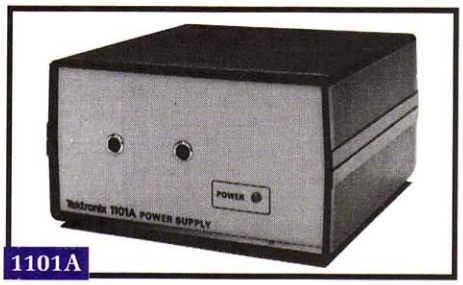
- Powers Up to Two Probes
- For Probe Use with Oscilloscopes that Do Not have Probe Power
- Compatible with the P6201, P602A, and P6230
- Overload Protected

1102

- Powers Up to Four Probes
- For Probe Use with Oscilloscopes that Do Not have Probe Power
- Compatible with P6501, P6511A and A6501
- Overload Protected

1103

- Powers Up to Two Probes
- For Use with 11000 Series Probes on Non-TEKPROBE™ Interfaced Oscilloscopes
- For Use with the P6203/P6204/ P6205/P6217 Active Probes and P6231 Bias-Offset Probe
- Overload Protected



1101A

1102

1103

The 1101A, 1102, and 1103 are accessory power supplies that provide external power to probes, when the oscilloscope used does not have the capability to supply probe power. All power supplies are overload protected. The 1102 and 1103 have a convenient On/Off switch (located on the back panel).

The 1101A has two power receptacles that will power up to two independent probes, such as the P6201, P6202A, and P6230.

The 1102 has four power receptacles that will power up to four independent probes, such as the P6511 spring contact probe. With the 174-0943-00 interface cable, the 1102 will power the P6501 microprobe or A6501 buffer amplifier.

The 1103 allows customers to use probes requiring TEKPROBE™ Interface power with any oscilloscope or digitizer which does not provide TEKPROBE™ power. The 1103 has dual TEKPROBE™ inputs, dual BNC signal outputs, and dual voltage offset on/off switches and potentiometers.

The offset control supplies a voltage, adjustable via the front panel potentiometer. This voltage is used to control offset of probes such as the P6700 Series optical to electrical converters or the P6203/P6204/P6217 Active Probes.

Characteristics

Electrical

	1101A	1102	1103
Output Voltage ±2%	+15 V +15 V +5 V	+15 V −15 V +5 V −5 V	+15 V −15 V +5 V −5 V
Output Current	300 mA	300 mA	300 mA
Outputs			
Pin 1:	+5 V	+5 V	n.c.
Pin 2:	Common	+15 V	n.c.
Pin 3:	−15 V	−15 V	+5 V
Pin 4:	+15 V	−5 V	+15 V
Pin 5:		Common	Offset ±1 V
Pin 6:			−5 V
Pin 7:			−15V
Line Frequency	48 to 440 Hz.		
Power Consumption	≤30 W	≤35 W	≤35 W.
Line Voltage			
Low Range	87 VAC to 128 VAC		
High Range	174 VAC to 250 VAC		

Physical Characteristics

Dimensions	**cm (in.)**	**cm (in.)**	**cm (in.)**
Depth	16.5 (6.5)	16.5 (6.5)	17.8 (7.0)
Width	15.8 (6.2)	15.8 (6.2)	15.8 (6.2)
Height	8.9 (3.5)	8.9 (3.5)	8.9 (3.9)
Weight	**kg (lb)**	**kg (lb)**	**kg (lb)**
Net	1.6 (3.5)	1.6 (3.5)	1.8 (3.9)

ORDERING INFORMATION

1101A
Accessory Power Supply **$525**

1102
Accessory Power Supply **$465**

1103
TEKPROBE™ Power Supply **$495**

INTERNATIONAL POWER PLUG OPTIONS

Opt. A1 – Universal Euro, 220 V 50 Hz ..... **NC**
Opt. A2 – United Kingdom, 240 V 50 Hz ..... **NC**
Opt. A3 – Australian, 240 V 50 Hz ..... **NC**
Opt. A4 – North American, 240 V 60 Hz ..... **NC**
Opt. A5 – Switzerland, 220 V 50 Hz ..... **NC**

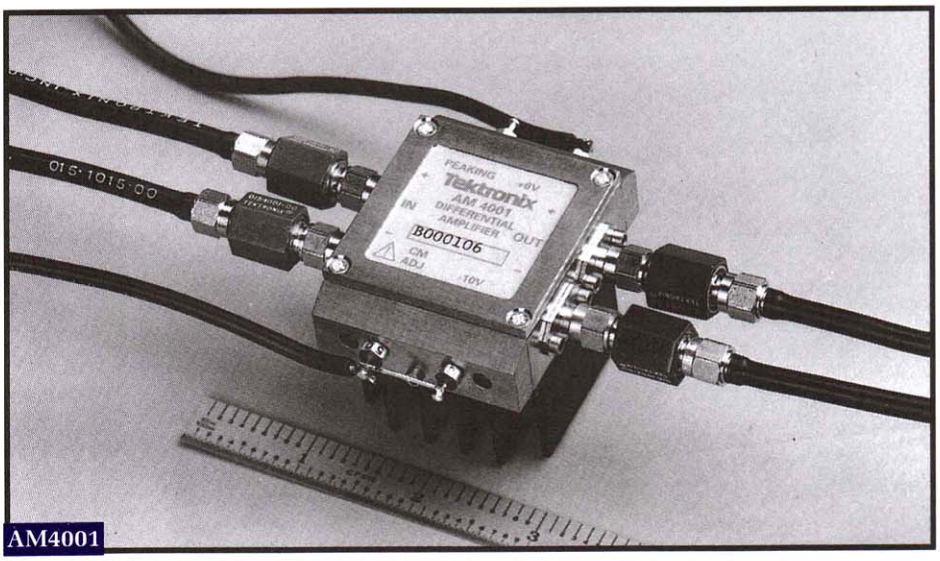
See General Customer Information Section for additional description.

ADDITIONAL ACCESSORIES (FOR 1103)

36 Inch Precision 50 Ω BNC cable – Order 012-0482-00 ..... **$35**
50 Ω Feedthrough Termination – Order 011-0049-01 ..... **$35**

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

Differential Amplifier



AM4001

AM4001 Differential Amplifier

The Tektronix Differential Amplifier provides performance previously unavailable in commercial amplifiers. The product quality and design expertise in Tektronix Test & measurement instrumentation is now available in this stand alone amplifier.

This DC coupled amplifier offers response flatness of less than 1 dB from 1 MHz to 2.5 GHz with an upper –3 dB bandwidth of 4 GHz.

Roll off of response above 4 GHz is gradual, providing usable gain beyond the –3 dB bandwidth.

The step response has minimal aberrations and ringing with a typical risetime of 92 ps. An external peaking control input allows optimization of response for minimum pulse overshoot or best frequency response flatness.

Differential inputs and outputs provide excellent noise immunity and stability. Differential output mode enables up to 8 V peak-to-peak differential drive capability.

Single-ended mode can be in-phase or inverting. Inputs and outputs can be used single-ended by terminating the unused ports. The second input can be used for an offset control.

Output and input connectors are all SMA for compatibility with standard high frequency modules and test equipment. Excellent gain flatness and VSWR allows modules to be cascaded without introduction of ripples in the passband.

The unit is small, light, and completely shielded for use in high field strength environments. The integral heat sink allows free standing operation up to 50°C.

Characteristics

Bandwidth – >4 GHz (–3 dB)*.

Voltage Gain – 18 dB ±1 dB differential, 12 dB ±1 dB single-ended, (both at 1 MHz)*.

Gain Flatness – <1 dB (between 1 MHz to 2.5 GHz).

1 dB Compression Point – 16 dBm at 50 MHz, 13 dBm at 3 GHz (each output, 50 Ω load).

Noise Figure – 13 dB single ended in and single-ended out (1 GHz to 4 GHz).

Input VSWR – ≤2.5:1 differential or 2.5:1 single-ended (DC to 4 GHz).

Rise/Fall Time – 90 ps (0.35/Bandwidth).

Pulse Aberrations – <5% peak-to-peak within first ns. See Typical Step Response Figure.

Pulse Flatness – For time intervals >1 ns a monotonic settling occurs that is <5% in the first microsecond and 15% in the first ms.

Output Common Mode Level – 0 ±0.5 VDC (adjustable to 0).

Output Differential DC Offset – <0.5 V*.

Common Mode Rejection Ratio – 2500:1 (DC to 1 GHz) 68 dB.

AM4001

- Driver For Multi-GHz Fiber Optic Laser Transmitters
- EW,ECM and Advanced Radar
- Level Matching Between System Blocks

FEATURES

- Excellent Pulse Response
- 1 MHz to 4 GHz Bandwidth
- 18 dB Gain Differential
- Differential Inputs and Outputs
- Inputs and Outputs at Ground Level
- Outputs up to +2 V into 50 Ω for Each Output
- Modules Can be Cascaded to Achieve Gain in Multiples of 18 dB
- Small Package can be Supported from SMA Connectors

Preamplifier for Realtime or Sampling Oscilloscopes, and Spectrum Analyzers

ORDERING INFORMATION

AM4001
Differential Amplifier **$4,000**
Includes: Carrying Case (202-0206-00), two 50 Ω SMA Terminations (015-1022-00), two 50 Ω SMA Short Circuit Terminations (015-1020-00).

Each AM4001 is shipped with data showing its measurement gain versus frequency, step response, and DC offset. All measurements at 25°C, using the Tektronix CSA 803 Oscilloscope and custom software.

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

P6511A
P6513A

A6501
P6501
P6507

Spring Contact/ Fixtured Probes

Probe for Bed-of-Nails Fixture... Low Circuit Loading and High Bandwidth Signal Acquisition.

P6511A/P6513A

- In Bed-of-Nails Fixtures
- Other Fixtured Applications Which Require High B/W, Low Loading
- DC to 300 MHz Bandwidth (250 MHz for P6515/P6517)
- High Impedance (1 M Ω, <3.8 pF for P6511/P6513) (<4.0 pF for P6515/P6517)
- 50 Ω Input
- Standard 100-MIL or 2.54 mm Spacing (P6511/P6513)
- Standard 50-MIL or 1.27 mm Spacing (P6515/P6517)
- Automated Scanning Available

A6501

- Use in Test Fixtures
- Mount on Probe Cards
- Place onto Circuit Boards
- DC to 1 GHz Bandwidth
- High Impedance (1 MΩ, <2.5 pF)
- Drives 50 Ω Coaxial Cable
- 10X Attenuation
- Replaceable Probe Tips

P6501/P6507

- For Hybrid and SMT Probing
- Mount on Probe Cards
- Use in Probing Stations
- DC to 750 MHz Bandwidth
- High Impedance (1 MΩ, <1.8 pF)
- 50 Ω Input
- 10X Attenuation
- Replaceable Probe Tips

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

P6511A/P6513A

P6511A/P6513A

The P6511A and P6513A are 10X, DC-to-300 MHz probes designed for placement into a bed-of-nails fixture or other fixtured applications. The probe is designed for low circuit loading and high-bandwidth signal acquisition. This enables acquisition of AC parametric waveform information from high-impedance test points.

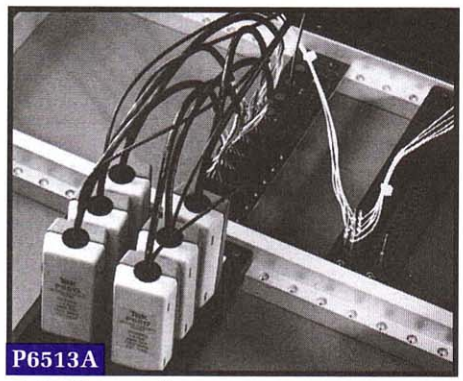
Electrically, the probe consists of a high impedance spring-loaded contact and active circuitry to drive a 50 Ω transmission line. The probe's spring contact receptacle allows the user to interchange spring contacts to accommodate a variety of different tip configurations.

P6511A has a standard twist-on BNC; the P6513A has a push-on BNC for ease of connection when used with the Tektronix TSI (Test System Interface). Power connection is made with a Berg connector for the P6513A. The P6511A uses a DIN connector for power. The 1102 power supply powers up to four P6511As.

Programmable P6513A scanning is provided by the TSI family of products. Complete support packages including probe power, are available for 12 probes. These packages facilitate use of the probes in automated testing applications such as functional board test. The probe receptacle's diameter permits mounting on 100 MIL centers, used in most circuit board testing.

A6501

The A6501 is a high performance 10X, DC-to-1.0 GHz FET input buffer amplifier designed for placement onto a circuit board, probe card or bed-of-nails test fixture. The A6501's versatile connection design provides connection to the circuit board or fixture by either twisted wires, spring loaded contacts, or 0.100 in. (2.54 mm) pitch leads. The A6501 features low input capacitance, high input impedance, and drives a 50 Ω load. (See characteristics next page)



P6513A

P6513A in test fixture.

Characteristics (P6511A/P6513A)

ELECTRICAL

Bandwidth – 300 MHz.

Attenuation – 10X.

Input R – 1 MΩ.

Input C – ≤3.8 pF.

Dynamic Range – ±15 V.

Max Nondestructive Input Voltage – ±30 V at DC.

Power Supply Requirements – ±15 V at 30 mA/ ±5 V at 45 mA.

Low-Frequency Compensation – Fixed, flat ±3%.

Propagation Delay – 3.8 ns ±100 ps.

Probe Aberrations – <±6%, 8% p-p in the first 4 ns; <±2%, 3% p-p after 4 ns.

Output Zero – <±2 mV.

DC Thermal Drift – <50 μV/°C.

PHYSICAL

Net Weight – 2.0 oz (56 g).

Recommended Minimum Center Spacing – 0.100 in. (2.54 mm).

Recommended Travel (2/3 Full) – 0.167 in. (4.24 mm).

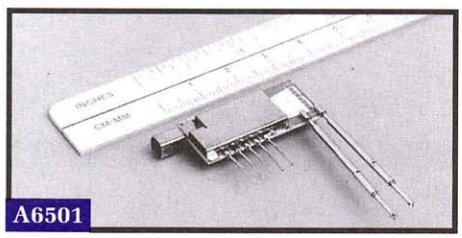
Spring Force – Pre-loaded 2.0 oz (57 g) ±20%; 2/3 travel: 5.5 oz (155 g) ±20%.

Mounting Hole Diameter – .067 in. to .069 in. (1.70 to 1.75 mm).

Receptacle (outside diameter) – 066 in. (1.68 mm).

Length – Signal: 22 in.; Power 12 in.

Power Interface – P6511A: Din Connector; P6513A: Berg Connector.



A6501

Spring Contact/ Fixtured Probes

A6501	P6511A
P6501	P6513A
P6507	

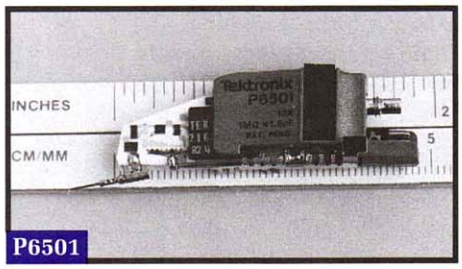
P6501

The P6501 Microprobe is a 1M Ω input active probe optimized for probe card mounting and probing stations. Its very low profile about (0.5 in. high) avoids interference with the objective lens of microscopes and lasers. The narrow body (about 0.100 in. wide) makes it well suited for high-density probing applications.

The power and signal cables can be conveniently removed for set up and storage of probe cards between uses. The 50 Ω coaxial signal uses a miniature 50 Ω connecter at the probe end and a BNC connecter on the instrument end. Note the probe's power requirements.

P6507

The P6507 Microprobe is a 50 Ω input probe and companion to the P6501. The probe can be used as either a 50 Ω input or output probe in card-mounted applications. It consists of a 30 mil thick Alumina hybrid substrate with a 50 Ω stripline and a miniature 50 Ω connector. The P6507 maintains a low profile thus allowing use of multiple probes in dense microprobing of hybrid's, SMDs and other high density circuits.



P6501

Characteristics (A6501/P6501/P6507)

Bandwidth – A6501: 1 GHz; P6501: 750 MHz; P6507: 1 GHz.

Rise Time – A6501: 350 ps; P6501: 450 ps; P6507: 350 ps.

Attenuation – A6501: 10X; P6501: 10X; P6507: 1X.

Input R – A6501: 1 MΩ; P6501: 1 MΩ; P6507: 50 Ω.

Input C – A6501: ≤2.5 pF; P6501: ≤1.8 pF; P6507: N/A.

Dynamic Range – A6501: ±10 V; P6501: ±10 V; P6507: N/A.

Maximum Nondestructive Input Voltage – A6501: ±26.5 V; P6501: ±26.5 V; P6507: ±42.5 V.

Power Supply Requirements – A6501: ±15 V at 20 mA, ±5 V at 17 mA. P6501: ±15 V at 20 mA, ±5 V at 17 mA; P6507: N/A.

ORDERING INFORMATION

P6511A
10X, 300 MHz Spring Contact Probe **$300**

P6513A
10X, 300 MHz Spring Contact Probe **$300**
Both Include: 2 Signal Receptacles, 4 GND Receptacles; Five 100-MIL Crown Spring Contact Tips;*1 4 GND Leads; Instruction Manual (070-8482-00).

RECOMMENDED ACCESSORIES (P6511A, P6513A)
Manuals – P6511A, P6513A. Order 070-8482-00. ..... **$15**
Power Connector – To power P6511A probe from other supplies. Order 131-4408-00 ..... **$14**
1102 Power Supply – For P6511A **$475**
System Interface Kits –
To interface P6513A probe to test systems such as the TSI family. See two kits below:
ITA Probe Scanner Kit – Support for one fixture. Order 021-0443-00 ..... **$145**
ITA/Rcvr/Power Probe Scanner Kit – Support for one TSI System. Order 021-0444-00 ..... **$400**

A6501
1 GHz, 1 MΩ, 10X Buffer Amplifier. **$410**
Includes: 3-3/4 in. and 10-1/4 in. Peltola (50Ω) signal cables, Peltola-cable-to circuit-board adapter, three 0.1 in. spring contacts, 0.1 in. pitch lead frame; Instruction sheet/Application notes (070-7308-00)
Note: Requires power from one of recommended power configurations.

P6501
750 MHz, 1 MΩ, 10X Microprobe **$550**
Includes: Two tungsten probe tips (206-0371-01); Ground lead (196-3141-00); Instruction sheet (070-6300-00)
Note: requires power from one of the options below or recommended power configurations.
Opt. 01 – Add 115 VAC, 60 Hz power supply ..... **+$165**
(119-2461-00) and 1.5 m 50 w cable (174-0538-00).
Opt. 02 – Add TEKPROBETM cable (015-0540-00) ..... **+$205**
Includes: Power cabling and signal cable. For use with 11K, TDS.

P6507
1 GHz, 50 Ω, 1X Microprobe **$85**
Includes: One tungsten probe tip (206-0371-01); Instruction sheet (070-6301-00)
Opt. 01 – Add 0.5 m, 50 Ω cable assembly (174-0668-00) ..... **+$60**

RECOMMENDED POWER CONFIGURATIONS FOR A6501 AND P6501
Wall Mount Power Supply – 115 VAC, 60 Hz. Order 119-2461-00 ..... **$145**
1102 Power Supply*2 – Powers 4 A6501, P6501 or P6511A probes (Requires power cable for A6501 and P6501) **$465**
Power Cable for 1102 Power Supply – Order 174-0943-00 ..... **$135**
TEKPROBE™ Power Cable – For TDS400/500/600 Series, 11K Series and Plug-ins or 1103 TEKPROBE Power Supply **$175**
Includes: Power and signal cable combined. Order 015-0540-00.
2x3 Power Connectors – Male connector. Order 131-3941-00 ..... **$27**
Female connector. Order 131-3821-01 ..... **$60**

RECOMMENDED ACCESSORIES (A6501, P6501, P6507)
Peltola-to-BNC Adapter – A6501. Order 131-1315-01 ..... **$9.25**
100 MIL Centers Spring Contacts – A6501 Pkg of 10. Order 016-0946-00 ..... **$50**
Manual – P6501. Order 070-6188-00 ..... **$10**
50 Ω Cable Assembly – P6501. Sealectro Miniature to BNC, 1.5 m. Order 174-0538-00 ..... **$43**
Ground Lead Assembly – P6501. Order 196-3141-00 ..... **$10**
Micro Positioner Arm, Adapter Assembly – For P6501. Order 013-0234-00 ..... **$800**
50 Ω Cable Assembly – P6507. Sealectro Miniature to BNC, 0.5 m. Order 174-0668-00 ..... **$43**
Ground Lead Assembly – P6507. Order 196-3141-00 ..... **$10**

REPLACEABLE PROBE TIP (P6501/P6507)
The P6501/P6507 probe tips are easily replaced as they wear or different applications are required.
Standard Length Tips – 0.20 in. (5.08 mm)
Tungsten Probe Tip – For thick-film, Pkg. of 5. Order 206-0371-02 ..... **$30**
Palladium Probe Tip – For thin-film, Pkg. of 5. Order 206-0370-02 ..... **$38**
Long Length Tips – 0.46 in. (11.6 mm)
Tungsten Probe Tip – For Thick-film, Pkg. of 5. Order 206-0371-03 ..... **$30**
Palladium Probe Tip – For thin-film, Pkg. of 5. Order 206-0370-03 ..... **$38**

**1 Available in packages of 10 receptacles and tips or order directly from Q.A. Technology.*
**2 See page 438 for International Power options.*

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

Surface Mount Device Probing and Interconnects

P6562
SMG50
SMGK51
SMGK52

PQFP100
PQFP132
SMCK1
SMQK1

For attachment to a variety of fine pitch surface mount devices.

P6562

- 10X, 350 MHz
- Easier Access to Multiple Point Connections
- Access to 0.050 Inch Lead Centers

APPLICATIONS

- Research and Design
- Manufacturing Test of SMT Circuitry
- Servicing of Circuitry with SMT Devices
- Prototype Debug and Design

SMG50/SMGK51/ SMGK52 SMT KLIPCHIP™ KITS

- Access to 0.050 inch Centers PLCC, SOIC, and other Packages with the SMT KlipChip™ Adapter
- Signal Insertion and Temporary Lead Jumpers without Soldering

PQFP100/132 PQFP ADAPTER CLIPS

- 386SX Attachment with PQFP100
- 68020/68030 Attachment with PQFP132
- 350 MHz Bandwidth
- Small Low-Profile Design Fits in Tight Spaces

SMCK1/SMQK1 SOIC/PLCC ADAPTER KITS

- Assortment of SOIC or PLCC Clips
- Leads and SMT KlipChips Included

TD

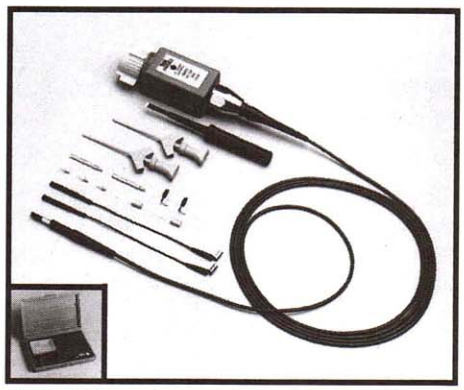
SMG50, SMGK52, PQFP100, PQFP132, SMCK1, SMQK1 also available within 24 hours through TekDirect. Call 1-800-426-2200

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

Surface Mount Device Probing and Interconnects

The increasing use of surface mount technology (SMT) brings many benefits to electronic circuit board (ECB) design and manufacture. Among these are increased circuit density, increased product reliability, and lower assembly costs.

Troubleshooting and device interconnection, however, have become more difficult due to decreased device size, tighter lead spacing and increased ECB densities. Tektronix' new offering of the following SMT probing and inter-connect devices meets these demanding requirements.



P6562 SMT Probe.

P6562 SMT Probe

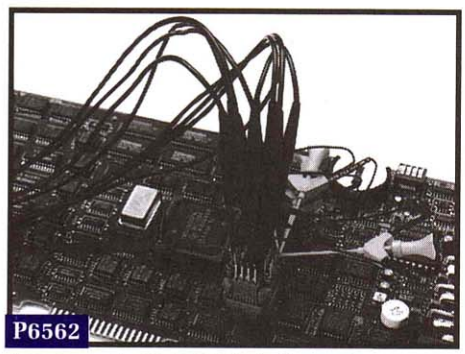
The P6562 SMT probe features a low-mass probe head and ultra-lightweight cable for easier, quicker and more stable circuit attachment. Multiple probes can now be attached to PLCC, SOIC, Tektronix KLIPKIT, and DIP IC Test Clips. The probe's light weight prevents it from disconnecting from the DUT (device under test), a common problem with heavier probes.

The P6562 features modular construction, hybrid and SMT circuitry, a readout pin which activates the readout encoding circuitry of so equipped oscilloscopes, and a small geometry probe tip that easily negotiates dense circuitry and tight spaces.

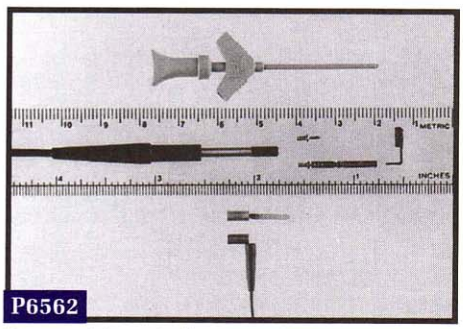
It is designed for use in digital circuitry and telecommunication/computer backplanes.

SMT KlipChip™

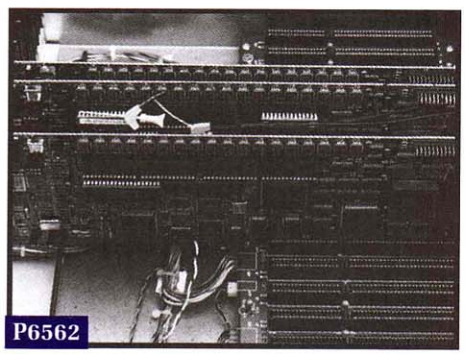
The SMT KlipChip™ is an interface device for attachment of logic and analog probes to today's SMD's, DIP's, and discrete components. The SMT KlipChip™ is capable of attaching to components with maximum lead diameters of 0.095 inches and stackable on lead centers of 0.050 inches. Dual sided 0.025 inch lead contacts allow this grabber to be used in multiple signal insertion/acquisition.



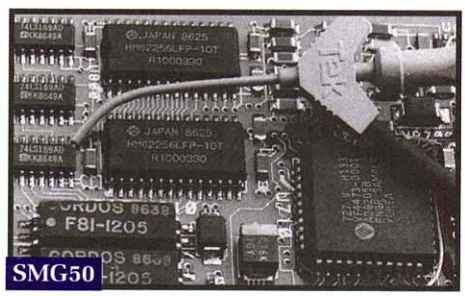
P6562 used with PLCC Clip (0.025 in. square pin adapter).



P6562 with typical accessories.



P6562 used in card cage application.



SMT KlipChip™ used on SOIC package.

Surface Mount Device Probing and Interconnects

P6562	PQFP100
SMG50	PQFP132
SMGK51	SMCK1
SMGK52	SMQK1

PLCC Quad Clips

For easy connection to Plastic Leaded Chip Carriers (PLCC) with "J" leads on .050 inch centers. Gold plated contacts maintain low contact resistance. .025 inch square pins provide contact for probes, flying leads, etc.

SOIC Clips

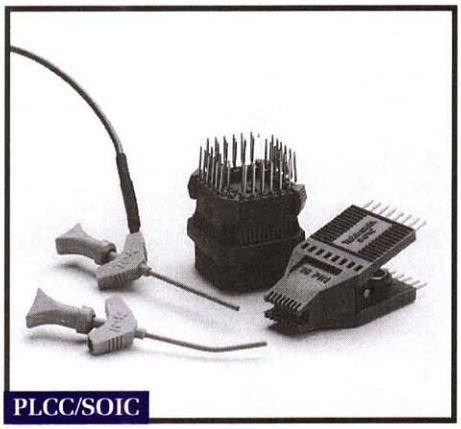
Simplify connection to Small Outline Integrated Circuits (SOIC). The spring design provides a strong and accurate fit. Compatible with gull-wing or "J" leads on .050 inch centers. Gold plated contacts for low contact resistances; .025 inch upper square pins provides access for probe or flying lead connection.

PQFP100/132

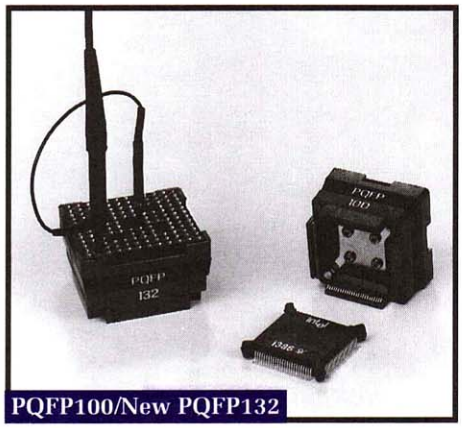
The PQFP100 and PQFP132 provide easy probe access to soldered-in 100 or 132 pin Plastic Quad Flat Pack (PQFP) Jedec standard devices. The molded bottom of the clip fits snugly to the PQFP device allowing single or multiple probe interconnects without risk of detachment.

The top of the clip is a pin grid array socket which provides simple attachment for various probing options such as:

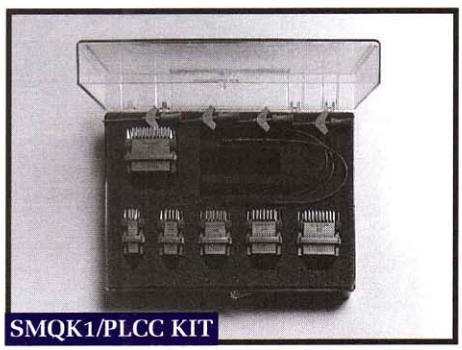
- P6562 -350 MHz SMT Probe; also P6139A or P613X Family
- Conventional Probes using included Signal/Ground Pins
- Matching PGA Adapter
- Available Male PGA Adapter for Square Pin Connections



PLCC/SOIC

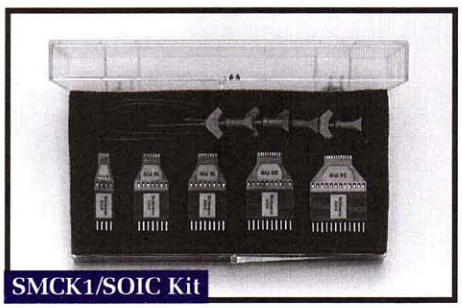


PQFP100/New PQFP132



SMQK1/PLCC KIT

The compact, low profile design makes it possible to probe devices on densely populated ECB's or where access space is limited.



SMCK1/SOIC Kit

Loading and crosstalk are minimized and bandwidth is greater than 350 MHz for high measurement precision.

P6562 CHARACTERISTICS

Cable Length	Atten-uation	Bandwidth at -3 dB	Compensation Range	System Input Resistance	Typical Input C	Gnd Ref	Readout	ID	Max Voltage DC + pk AC
1.5 m	10X	350 MHz	15 to 30 pF	10 MΩ	10.3 pF		√		42 V

ORDERING INFORMATION

P6562
350 MHz,10X, 1.5 m SMT Probe **$260**
Includes: Adjustment Tool (003-1433-00); 2 each KlipChip™ Adapters (206-0364-00); 2 each 4 in. Ground Leads; 3 each screw-in Probe Tip; 2 each screw-in 0.025 in. Jack Tip Assembly; 2 each Right Angle Square Pin Adapters; 2 each low inductance Ground Leads; 2 each Circuit Board Connectors; Instruction Sheet (070-7792-00). See page 479 for additional accessories.

SMG50
SMT KlipChip™ ..... TD **$89**
Includes: 20 SMT KlipChip™.

SMGK51
SMT KlipChip™ Adapter Leads **$50**
Includes: 4 KlipChip™ Adapters; 3 Electrical Leads.

SMGK52
SMT KlipChip™ Adapters ..... TD **$80**
Includes: 5 SMT KlipChip™ Adapter; 3 Electrical Leads; 1 Dual Lead Adapter; 1 Flex Tip Adapter.

SMCK1
SOIC Engineering Kit ..... TD **$99**
Includes: 1 each of 8, 14, 16, 20, 24 Pin SOIC Clips plus 4 SMT KlipChip™ Adapter; 8 Electrical Leads with (0.025 in.) Square Pin Connectors.

SMQK1
PLCC Engineering Kit ..... TD **$270**
Includes: 1 each of 20, 28, 44, 52, 68, 84 Pin PLCC Clips plus 4 SMT KlipChip™ Adapter; 8 Electrical Leads with (0.025 in.) Square Pin Connectors.

PQFP100
Converter Clip ..... TD **$260**
Includes: Convenient Storage Case; 5 each Signal/Ground Adapter Pins (131-5336-01); Instruction Sheet (070-8171-00).

PQFP132
Converter Clip ..... TD **$300**
Includes: Convenient Storage Case; 5 each Signal/Ground Adapter Pins (131-5336-01); Instruction Sheet (070-8171-00).

PQFP100/PQFP132 RECOMMENDED ACCESSORIES
Adapter Shim for PQFP132 Pin Packages –
Order 361-1599-00 ..... **$1.50**
Signal/Ground Adapter Pins – Pkg of 25.
Order 131-5336-01 ..... **$7.50**
PQFP100 Pin Male PGA Adapter to 0.030 in. Round Pin –
Order 103-0278-00 ..... **$13.75**
PQFP132 Pin Male PGA Adapter to 0.030 in. Round Pin –
Order 103-0324-00 ..... **$35**

TD
SMG50, SMGK52, PQFP100, PQFP132, SMCK1, SMQK1 also available within 24 hours through TekDirect. Call 1-800-426-2200

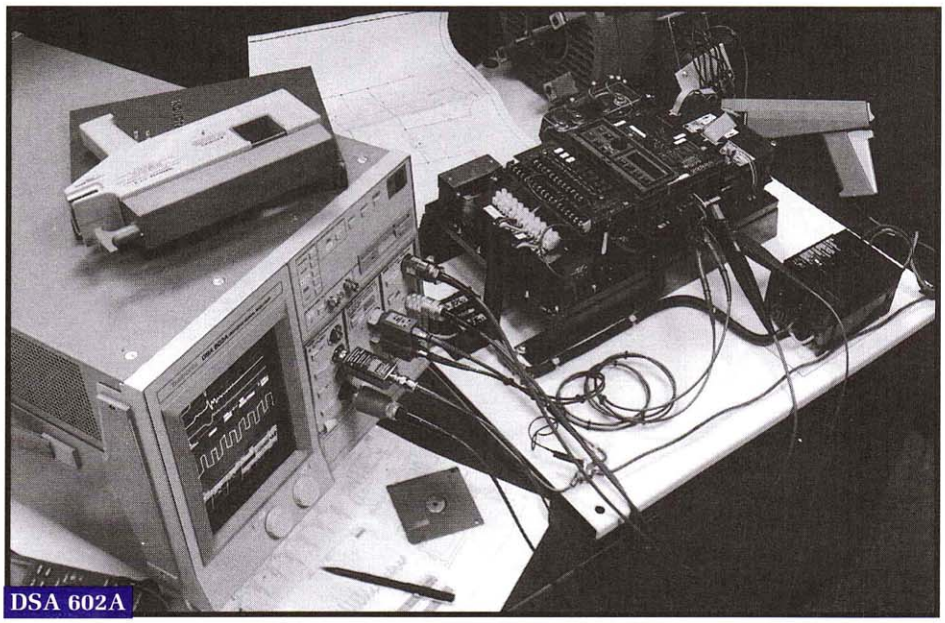
To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

Power Measurements

Tektronix has what you need to design and test power applications such as Power Supplies, Motor Control, Avionics, Electric Vehicles, Electronic Ballasts, Disk Drives.

POWER MEASUREMENTS

- Current
- Time Intervals
- Differential
- High Voltage
- Isolation



Viewing three phase controller and motor signals with a DSA 602A using current, differential and high voltage probes.

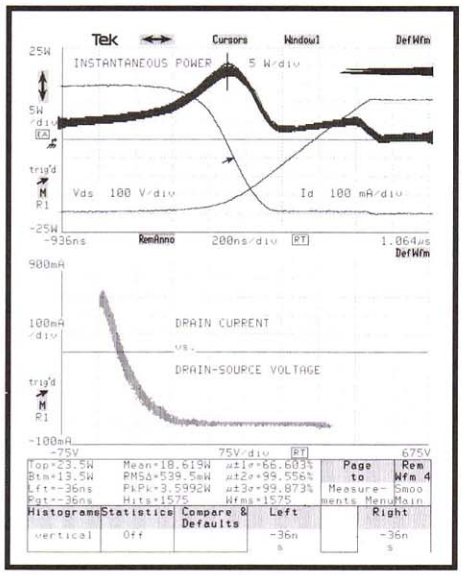
Power Measurements

Oscilloscopes utilize voltages, presented at their inputs, to provide amplitude versus time displays, and offer a wide range of analysis capabilities. These voltage signals are typically referenced to ground and less than 500 V. While providing valuable information about what is occurring in your device, it is clear that knowledge of currents, time intervals, voltages greater than 500 V, differential voltages and temperatures may all be required to completely understand what is happening with your application.

In the following sections we describe a selection of probes and devices which enable you to safely and accurately capture current, pulse modulation, differential, and high voltage signals – all converted to voltage inputs acceptable to your oscilloscope or other measurement instrument.

While current and differential voltage measurements are important to most electrical and electronic applications, high current and voltage measurements are especially critical in power conversion applications. These applications include devices characterized by high currents and differential voltages which change rapidly as the devices switch on and off. In these applications, safety as well as accuracy is of critical importance. The special needs of these applications are addressed by the group of products we refer to as power measurement products.

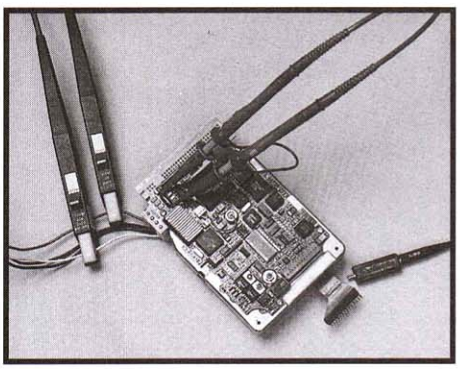
In the following pages we describe each category of measurement products: Current probes, time to voltage converters, active and passive differential voltage probe systems, high voltage probes, isolators, and temperature and RF probes. We describe product features and applications and provide information to enable you to select the right device allowing you to safely and accurately make your measurement. We will also provide information about literature which provides valuable information on how to make measurements specific to your application.



A power measurement display on DSA602A. Current, voltage and instantaneous power in a power FET are shown in the upper display. The operating area of the turn-off transition is shown in the lower screen.

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

Power Measurements



A compact disk drive is tested using two A6302 current probes to monitor start up and steady state currents. A CT-2 current transformer measures AC write current. Differential voltage measurements are made with a P6135A probe pair. For information about disk drive measurements request application note 47W-8257-2.

Current Probes

Tektronix offers the widest selection of high performance current probes on the market. Providing simultaneous AC/DC measurements, bandwidth coverage from DC to 1 GHz, and current amplitude measurements from mAs to 1,000 A.

Current probes measure the flux field generated by the movement of electrons through a conductor. Within the range specifications of the current probe, the flux field strength is converted to a linear voltage output which can be displayed and analyzed on an oscilloscope or other measurement instrument.

Tektronix provides current probes in two current measurement categories which are subdivided into two mechanical groupings.

AC AND DC CURRENT MEASUREMENTS

AC currents induce voltage in a transformer by the build-up and collapse of flux fields as the current changes direction. AC only current probes are passive in that they do not require external power. A steady state DC current will not induce a current in a transformer. Taking advantage of the Hall Effect, a current biased semiconductor device will produce a voltage output in response to a DC generated flux field. Consequently, a DC current probe is an active device in that it requires external power.

Each type of current sensing device will roll-off, or produce a non-linear output at a certain point. A given AC probe will roll-off at a certain maximum current amplitude and frequency as well as at a minimum amplitude and low-end frequency. DC current probes will be linear from DC to a maximum frequency and will have a minimum and maximum sensitivity level as well. Since we often encounter signals which contain both AC and DC components, so it would be good to be able to measure both simultaneously with a single probe. Additionally, signals which may look like AC, such as a square wave which is switching on and off, but never fall below zero volts, actually have a significant DC component. These signals will be distorted by a transformer AC probe only.

SPLIT VERSUS SOLID CORE

The two mechanical current probe configurations are split core and solid core. To accurately measure the flux field, we need to completely surround the conductor with the probe core. Tektronix offers two configurations: split core and solid core. Split core probes offer convenience. Precisely engineered and manufactured, the split core probes can be clipped onto a conductor without having to break the connection.

Solid core current transformers (CT) offer small size and very high frequency response for measuring very fast low amplitude current pulses and AC signals. They are designed to be permanently or semi-permanently installed and have cables which are easily connected and disconnected to the CT.

In the following Current probe section, we will describe the features and characteristics of each of the Tektronix Current probes, as well as mention some of the primary applications for each.

CURRENT PROBE SELECTION GUIDE

Type	Bandwidth Hz to MHz	Peak Pulse	Max AC P-P	Derate Below	Derate Above	Max DC	Amp-S Product	Current/Div Display Range	Rise Time	Current	Core Style	Max Barewire Voltage	Max Conductor Diameter
A6302/AM 503	DC to 50	50 A	40 A		20 kHz	20 A	100 x10^{-6}	1 mA to 5 A*1	7 nS	AC/DC	split	500 V	0.15 in.
with CT-4	0.5 to 20	1 kA	1 kA	20 Hz	1.2 kHz		0.1	20 mA to to 5 kA*1	17.5 nS	AC	split	3 kV	1.50 in.
A6303/AM 503	DC to 15	500 A	200 A		20 kHz	100 A	10,000 x10^{-6}	10 mA to 50 A*1	23 nS	AC/DC	split	700 V	0.83 in.
P6021 with Passive Termination	120 to 60	250 A	15 A	300 Hz	5 MHz	0.5 A	500 x10^{-6}	20 mA*1 or 100 mA*1	5.8 nS	AC	split	600 V	0.14 in.
P6021 with CT-4	120 to 20	1 kA	1 kA	300 Hz	1.2 kHz	20 A	0.5	400 mA or 100 A*1	17.5 nS	AC	split	3 kV	1.50 in.
P6021 with 134	12 to 38	250 A	15 A	230 Hz	5 MHz	0.5 A	500 x10^{-6}	1 mA to 1 A*2	9.2 nS	AC	split	600 V	0.14 in.
P6021 with 134 and CT-4	25 to 20	1 kA	1 kA	230 Hz	1.2 kHz	20 A	0.5	20 mA to 1 kA*2	17.5 nS	AC	split	3 kV	1.50 in.
P6022 with Passive Termination	935 to 120	100 A	6 A	3 kHz	10 MHz	0.2 A	9 x10^{-6}	10 mA or 100 mA*1	2.2 nS	AC	split	600 V	0.10 in.
P6022 with 134	100 to 65	100 A	6 A	1.3 kHz	10 MHz	0.2 A	9 x10^{-6}	1 mA to 1 A*2	5.4 nS	AC	split	600 V	0.10 in.
CT-1	25 k to 1000	12 A	1.4 A			0.2 A	1 x10^{-6}	2 mA*1 (5 mV/mA)	0.35 nS	AC	solid	1000 V	0.070 in.
CT-2	1.2 k to 200	36 A	7 A			0.2 A	50 x10^{-6}	10 mA*1 (1 mV/mA)	0.5 nS	AC	solid	1000 V	0.052 in.

**1 Scope set at 10 mV/div.*

**2 Scope set at 50 mV/div.*

AM 503S / AM 503A — A6302 / A6303 Current Probe Systems

Simultaneous AC/DC current measurements. Ideal for measuring currents in switching power supplies, motor controllers, disk drives.

AM 503S

- AC/DC Current Measurement System
- With A6302 Probe:
  - DC to 50 MHz Bandwidth
  - 20 A Max Continuous/50 A Peak Pulse
- With A6303 Probe:
  - DC to 15 MHz Bandwidth
  - 100 A Max Continuous/500 A Peak Pulse

AM 503A

- Completely Redesigned Current Probe Amplifier
- Push Button Auto Balance/De gauss
- Bright LED Current/Division Display
- Microprocessor Controlled
- No longer need to calibrate amplifiers with specific probes

A6302

- AC/DC Measurements
- Split Core
- Clips-on to conductors up to 0.15 inch diameter
- DC – 50 MHz
- 20 A Continuous
- 100 A Peak

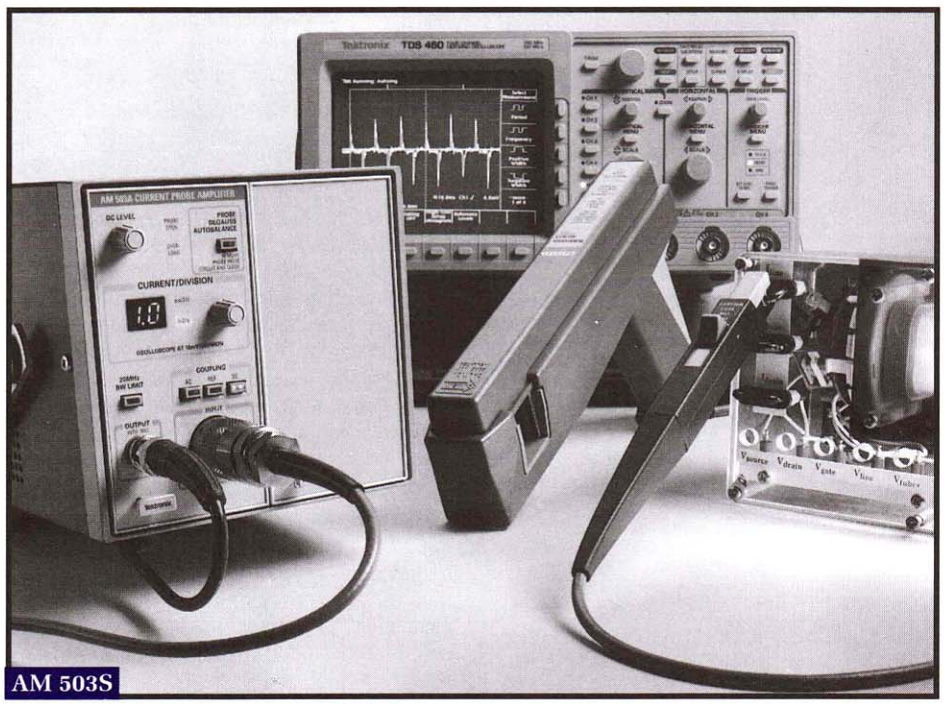
A6303

- AC/DC Measurements
- Split Core
- Clips-on to conductors up to 0.83 inch diameter
- DC – 15 MHz
- 100 A Continuous
- 500 A Peak

TD

AM 503S, Opt. 01, Opt. 03 also available within 24 hours through TekDirect. Call 1-800-426-2200

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.



AM 503S current probe system with both A6303 and A6302 current probes. The A6302 is measuring the fluorescent ballast line current which is displayed on a TDS 460 Digitizing Oscilloscope. For information about ballast testing request application note 51W-8614-0.

AM 503S Current Probe System

The AM 503S Current Probe System is the most sophisticated current measurement system available. Since the probes incorporate both a transformer and a Hall Effect Device, both AC and DC currents can be measured simultaneously. Depending on the probe used, currents from DC to 50 MHz and up to 100 amps can be measured accurately by simply clipping the split-core probes onto the conductor.

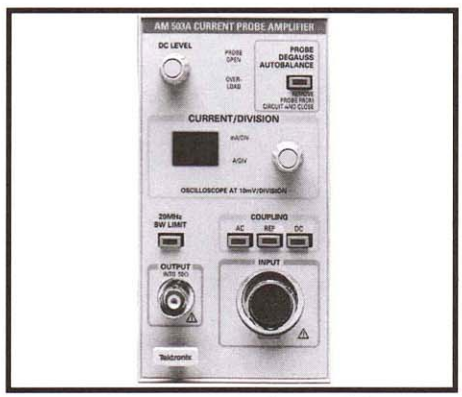
The AM 503S is truly a system, consisting of the new AM 503A Current Probe Amplifier, a two-wide TM 502A power module, an A6302 Current Probe and a handy plug-in tool-box. Options enable you to add or substitute the A6303 current probe or the single-wide TM 501A power module.

New AM 503A Current Probe Amplifier

The AM 503A Current Probe Amplifier is the heart of the AM 503S System. The AM 503A amplifies and sums the voltage outputs from the transformer and Hall Effect device and outputs it to the measurement instrument. It also provides the Hall Effect Device bias current and a reverse "bucking" current which resists saturation of the A6302/3 Current Probe core.

The AM 503A Current Probe Amplifier is a completely redesigned successor to the AM 503. All functions are microprocessor controlled providing a significant improvement in ease of use and functionality. The AM 503A uses bright easy to read LEDs to display Current/Division settings which are controlled with a single knob adjustment. A single push-button provides both degauss and autobalance functions. An additional significant improvement with the AM 503A is that individual A6302/3 probes no longer need to be calibrated with a specific amplifier but can be interchanged between AM 503As.

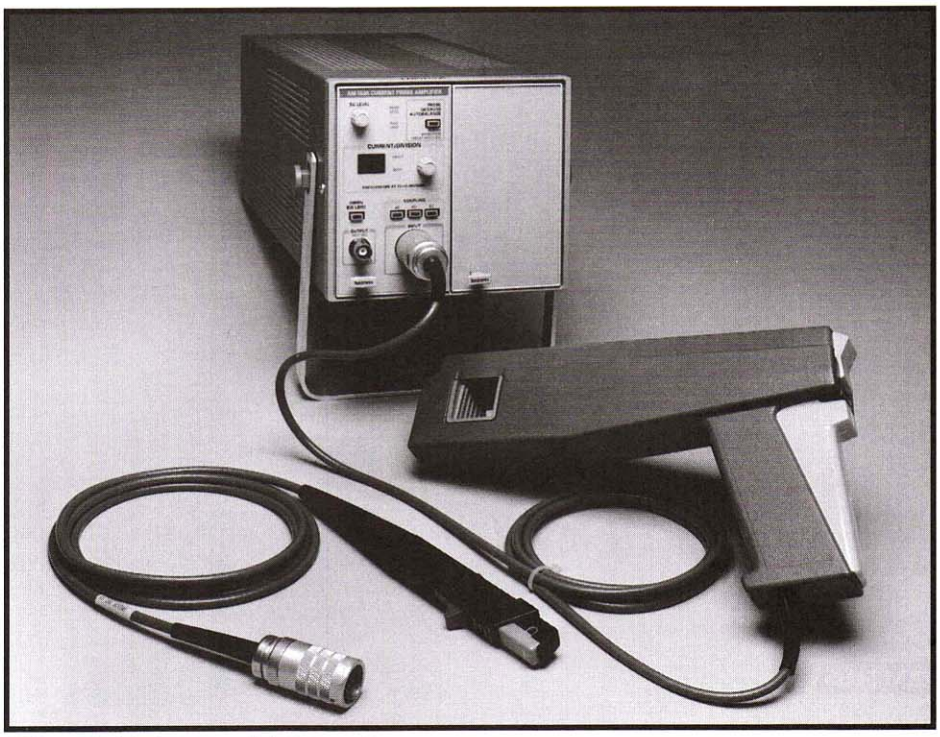
The AM 503A operates in any TM 500/TM 5000 Power module. The 50 Ω output of the AM 503A can be displayed on any oscilloscope or measurement instrument that has a sensitivity setting of 10 mV/Division. A 50 Ω output cable and termination is included with the AM 503A.



New AM 503A Current Probe Amplifier

Current Probe Systems

AM 503S **AM 503A** | **A6302** **A6303**



AM 503S with A6302 and A6304 probes.

The scope or measurement instrument requires at least a 200 MHz to display the full bandwidth of the A6302 and 60 MHz for the A6303. You can select either AC only mode or DC mode which allows you to display combined AC/DC current signals.

A6302 and A6303 Current Probes

The A6302 and A6303 current probes convert the DC and AC flux field of a conductor to a voltage signal which is sent to the AM 503A Current Probe Amplifier. the A6302/3 incorporate both a Hall Effect device which senses DC current and a transformer which senses the AC current. Both probes utilize a bucking current from the AM 503A to completely eliminate core saturation for up to 20 A for the A6302 and 100 A for the A6303. With the convenient split-core design they are easy to clip on and off of the conductor.

The A6302 and A6303 offer a wide range of current measurement capability. The A6302 covers frequencies from DC to 50 MHz. It clips onto conductors up to 3.81mm (0.15 in.) and can measure continuous currents up to 20 amps and peak currents up to 50 A (as long as they do not exceed the Amp ★ second product of 100 A ★ µS). The larger A6303 is for measuring higher amplitude, lower frequency currents. It clips onto conductors up to 21.1 mm (0.83 in). Its frequency range is from DC to 15 MHz and it will measure continuous currents up to 100 amps and peak currents up to 500 A as long as they do not exceed the Amp ★ second product of 10,000 A ★ µS.

The A6302 and A6303 are also compatible with the 11A16 Current Probe Amplifier for 11000 and DSA Series oscilloscope. With the 11A16, the A6302 is rated for 10.5 A and 52.5 A for the A6303. See page 83. The maximum AC current rating for the A6302 can be extended by using a CT-4 Current Transformer. See next page.

For additional information on the AM 503S Current Probe System, request Current Probe Data Sheet 51W-7955-1.

Amp ★ Second Product

As mentioned in the current probe introduction, transformer core materials saturate and become nonlinear when they are subjected to too much current. "Too much current" is a function of both the amplitude of the current and the time it is applied. The product of the average amplitude times the pulse width is called the AMP ★ SECOND product. Each probe has an amp second product specification (See the Current Probe Selection Guide). If the signal does not exceed this specification, the voltage output will be linear and the measurement accurate.

A special feature of the AM 503S Current Probe Systems utilizes the phenomenon that opposing currents are subtractive. The AM 503S senses the current level in the conductor under test and feeds an equal but opposite current through the probe. This "bucking current" nulls out the current in the transformer and eliminates any core saturation. There is a limit to the bucking current of 20 A in the A6302 and 100 A in the A6303. But up to these amplitudes you need not be concerned about the Amp ★ second product.

ORDERING INFORMATION

AM 503S
Current Probe System ..... TD **$2,595**
Includes: AM 503A Current Probe Amplifier; TM 502A Power Module; A6302 Current Probe; Plug-in tool box (016-0362-02); Operator's Manual (070-8170-00).

Opt. 01 – Adds A6303 Current Probe ..... TD **+$1,390**

Opt. 02 – Substitutes TM 501A for TM 502A, deletes Toolbox ..... **+$260**

Opt. 03 – Substitutes A6303 Current Probe ..... TD **+$645**

Opt. 04 – Substitutes A6303 Current Probe and TM 501A; deletes tool-box ..... **+$875**

AM 503S Service Manual – Order 070-8174-00 ..... **$125**

Current Loop – Order 015-0601-50 ..... **$80**

AM 503A
Current Probe Amplifier **$1,550**
Includes: 43 in. 50 Ω BNC cable (012-0057-01); 50 Ω BNC Termination (011-0049-01); Operator's Manual (070-8170-00). The AM 503 requires one of the TM 500/5000 Series power modules. See page 351.

A6302
2 m 20A Current Probe **$775**
Includes: 5-in. (130 mm) Ground Lead (175-0124-01); 3 in. (75 mm) Ground Lead (175-0263-01); 2 Miniature Alligator Clips (344-0046-00).

A6303
2 m 100A Current Probe **$1,420**
Includes: Carrying Case (016-0622-00).

Information for the use of the A6302 and A6303 Current Probes is included in the AM 503S Operator's Manual (070-8170-00). Service information is in the AM 503S Service Manual (070-8174-00).

TD
AM 503S, Opt. 01, Opt. 03 also available within 24 hours through TekDirect. Call 1-800-426-2200

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

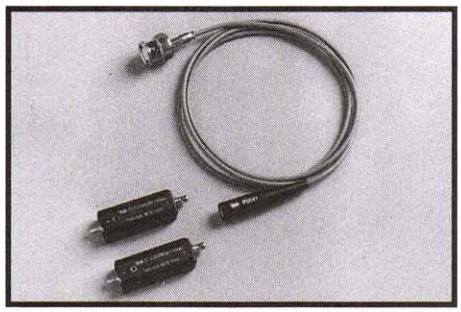
Current Probes

CT-1 and CT-2 Solid Core AC Current Transformers for fast, low amplitude current measurement. The CT-4 enables 1000 AC current measurements for automotive avionics and industrial power applications.

CT-1
- 25 kHz to 1 GHz
- 12 A Max Pulse Current
- 450 mA Max CW Current
- For 50 Ω Input
- AC Only
- Solid Core
- ESD Testing

CT-2
- 1.2 kHz to 200 MHz
- 36 A Max Pulse Current
- 2.5 A Max CW Current
- For 50 Ω Input
- AC Only
- Solid Core
- Disk Drive Read/Write Signals

CT-4
- Pulsed Currents to 1,000 A
- Continuous Currents Up to 700 A RMS
- Accepts 1.5 Inch Diameter Conductors
- Measurements on Bare Conductors to 3000 V
- Nullifies DC Effects to 300 A with DC Bucking Coil
- AC
- Split Core
- Use with A6302 or P6021



CT-1/CT-2 Current Probes with P6041 BNC Probe Cable.

CT-1/CT-2 Current Probes

The CT-1 and CT-2 Current Probes are designed for permanent or semipermanent in-circuit installation. Each probe consists of a current transformer and an interconnecting cable. The current transformers have a small hole through which a current carrying conductor is passed during circuit assembly.

The P6041 Probe Cable provides the connection between the CT-1 and CT-2 current transformers and a BNC oscilloscope input. A 50 Ω termination is required to terminate the cable at a high impedance (1 MΩ) oscilloscope input. One probe cable can be used to monitor several current transformers that have been wired into a circuit.

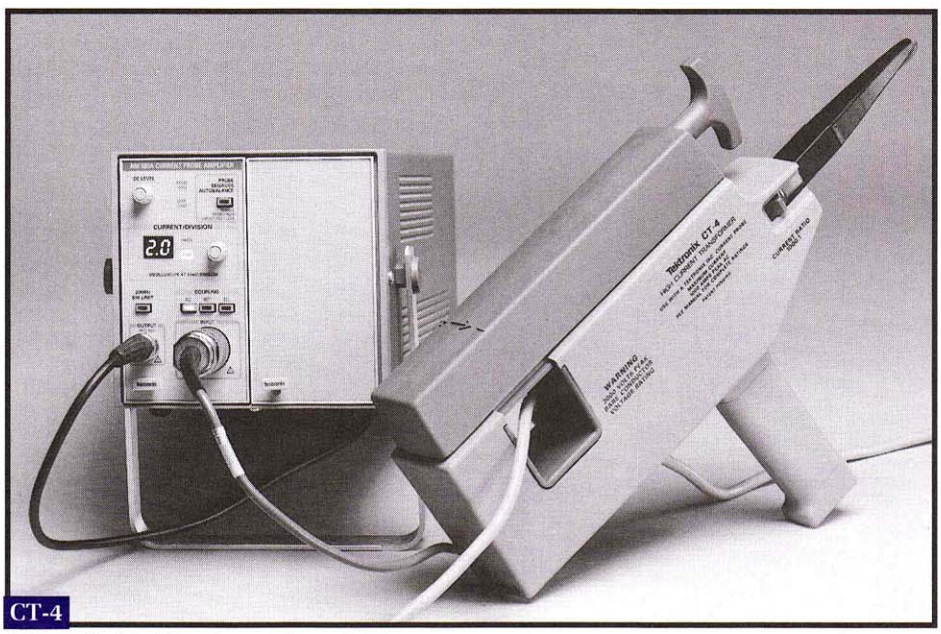
CT-4 Current Probe

The CT-4 is a robust clip-on high current transformer that extends the measurement capability of the P6021 and A6302 clip-on current probes. Maximum low frequency performance down to 0.5 Hz is obtained using the AM 503S. Current amplitudes to 1,000 amps may be measured using the A6302 or P6021 (with passive termination) provided the amp-second ratings are not exceeded.

The P6021 and 134 may be used for measurements at normal line frequency and above. (The P6022 and A6303 are not compatible with the CT-4).

The CT-4 has receptacles for current probes in either 20:1 or 1000:1 step-down ratios.

The 1.5 square split core opening makes it possible to clip onto large conductors without breaking the circuit under test. Insulated core and shield assemblies allow measurements on bare wires to 3000 V, and to 14 kV with the included high voltage bushing. A DC bucking coil assembly allows up to 300 A of steady state DC to be nullified (derates to 1 MHz B/W). This is very useful for measuring AC signals on top of a constant DC voltage level.



AM 503S with CT-4 Current Transformer.

ORDERING INFORMATION

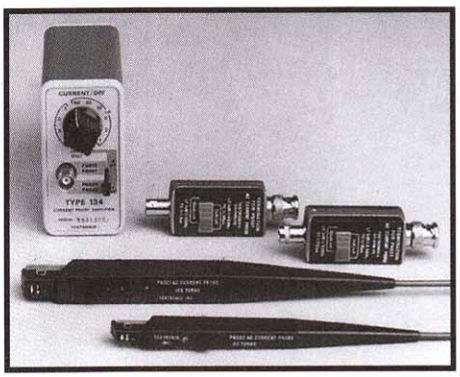
CT-1
Current Probe, Current Transformer and Probe Cable (42 in.). **$290**
Includes: Instruction Manual (070-0375-01).
Opt. 09 – Current Transformer only. ..... **–$90**

CT-2
Current Probe, Current Transformer and Probe Cable **$250**
Includes: Instruction Manual (070-0406-01).
Opt. 09 – Current Transformer only ..... **–$90**
P6041 – Probe Cable (42 in.) only **$95**

CT-4
Current Probe with DC Bucking Coil **$1,625**
Includes: Carrying Case (016-0191-03); 12-in. wide, 4 ft. long High Voltage Bushing (015-0194-00); DC Bucking Coil (015-0190-00); Instruction Manual (070-6478-00).

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

Current Probes



P6021 and 6022 AC Current Probes with Terminations and 134 Current Probe Amplifier.

P6021 Current Probe

The P6021 and P6022 Current Probes with the 134 Current Probe Amplifier provide a versatile AC current measurement system. Both probes provide accurate current measurements over a wide range of frequencies. The P6021 and P6022 allow current measurements without breaking the circuit by clipping onto the current carrying conductor. No electrical connection is required. Shielded probe heads are not grounded when the slides are in their open positions, eliminating accidental grounding of the circuit under test.

For general purpose applications the P6021 provides wide-band performance with excellent low-frequency characteristics. Bandwidth is 120 Hz to 60 MHz. The passive termination is switchable from 2 mA/mV to 10 mA/mV.

P6022 Current Probe

With a head size of 0.47 inches x 0.25 inches (10 mm x 6 mm) and a bandwidth of 935 Hz to 120 MHz, the P6022 is ideal for measuring currents in compact high performance circuits. Passive termination output is switchable between 1 mA/mV or 10 mA/mV.

134 Current Probe Amplifier

The 134 is used to extend the low frequency measurement capabilities and sensitivity of the P6021 or P6022 Current Probes. Using the 134 Amplifier extends the initial P6021 measurement capability of 120 Hz down to 12 Hz. The P6022/134 combination goes to 100 Hz from 935 Hz. The Current/Div switch provides calibrated current steps from 1 mA/div to 1 A/div (with the oscilloscope or plug-in unit adjusted for a deflection factor of 50 mV/div). When using a 134 with a P6021 or P6022, the passive termination is not required.

The 134 can also be used as an auxiliary voltage amplifier by placing the Current/ Div switch in the Volts position.

P6021

- 120 Hz to 60 MHz
- 15 A Peak
- For 1 MΩ Inputs
- Shielded Probe Heads
- AC Only
- Split Core

P6022

- 935 Hz to 120 MHz
- 6 A Peak
- For 1 MΩ Inputs
- Shielded Probe Heads
- AC Only
- Split Core

134

- Amplifier for P6021 and P6022
- P6021: 12 Hz to 38 MHz
- P6022: 100 Hz to 65 MHz

Versatile Clip-on probes for general purpose AC current measurements.

TD

P6021, P6021 w/134, P6022, P6022 w/134 also available within 24 hours through TekDirect. Call 1-800-426-2200

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

ORDERING INFORMATION

P6021
5 ft Current Probe with Termination ..... TD **$545**
Includes: 5 in. (130 mm) Ground Lead (175-0124-01); 3 in. 75 mm) Ground Lead (175-0263-01); Two Miniature Alligator Clips (344-0046-00); Instruction Manual (070-0947-0).

P6022
5 ft. Current Probe with Termination ..... TD **$595**
Includes: Same as the P6021; Instruction Manual (070-0948-00).
Opt. 03 – 9 ft. with termination, P6021 and P6022 ..... **+$45**

134
Current Probe Amplifier **$845**
Includes: Hanger assembly (014-0029-00); Cable Assembly (012-0104-00); Power Supply (015-0058-02); Instruction Manual (070-0990-01).

INTERNATIONAL POWER PLUG OPTIONS
Opt. A1 – Universal Euro 220 V, 50 Hz. ..... **NC**
Opt. A2 – UK 240 V, 50 Hz. ..... **NC**
Opt. A3 – Australian 240 V, 50 Hz. ..... **NC**
Opt. A4 – North American 240 V, 60 Hz. ..... **NC**
Opt. A5 – Switzerland 220 V, 50 Hz. ..... **NC**

ADDITIONAL ACCESSORIES
Carrying Case – For P6021 or P6022, and a 134 Amplifier. Order 016-0087-02 ..... **$75**
Passive Termination –
(P6021) – Order 011-0105-00 ..... **$170**
(P6022) – Order 011-0106-00 ..... **$210**
Power Supply – (110 VAC) Order 015-0058-02 ..... **$275**
Power Supply – (230 VAC) Order 015-0059-02 ..... **$340**

Instantaneous Time-Interval to Voltage Converter

A clear view into digital and PWM control.

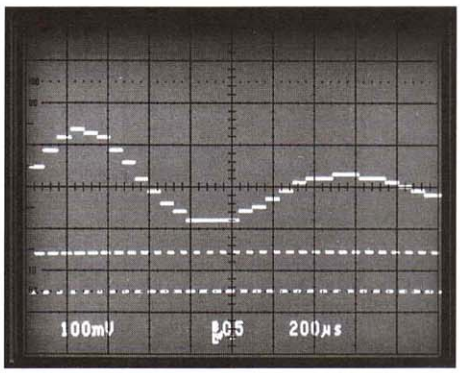
Compatible with analog scopes, digital scopes, and waveform analyzers.

TVC 501

- Real-time Scope Display of Time-Interval Variations vs. Time
- Time Delay, Pulse Width, and Period Measurements
- >2 Million Uninterrupted Event-by-Event Measurements/ Second

APPLICATIONS

- Switch Mode Power Supply PWM
- UPS Sinewave Synthesis
- Motor Drive and ASD Control
- Optical Encoder and Digital Servo Timing
- Engine Control Module PWM
- Processor Throughput Performance
- Digital Glitch Detection
- Telecom Signalling
- Oscillator Start-Up and PLL Acquisition Timing
- Switch Relay Bounce Dynamics



The TVC 501 instantaneously and continuously converts consecutive timing measurements to a time-interval vs. time waveform. The top trace (TVC output) shows the pulse-to-pulse width vs. time variations of the lower stream of pulses.

The Need for Time-Interval Measurements

Measuring parameters is no longer as simple as recording voltage vs. time. In digital or switching systems, signals are sampled, pulse-coded, or pulse-width modulated. Relevant information is in the varying time intervals between the signal transitions. It is in these time intervals that failures often occur. For example, control pulse widths in a switching power supply can be too long or short which can overdrive output transistors. Or an embedded controller's interrupt latency can be too long which can cause a system crash.

Timing variations typically appear as left-to-right motion or jitter on a scope. Timebase or trigger holdoff adjustments may improve display stability but do not show timing dynamics. The TVC 501 untangles the often confusing waveforms in digital systems and delivers a coherent and real-time view.

SAME SCOPE, MORE POWER

The TVC 501 adds three measurement functions to your scope's voltage vs. time capability: time-delay vs. time, pulse-width vs. time, and period vs. time.

The TVC continuously measures the timing parameter and instantaneously generates a voltage proportional to the measurement. Timing measurements are made with crystal controlled accuracy using digital counters. Conversions are performed pulse-to-pulse without averaging. The TVC output goes to any scope. The TVC 501 provides seven vertical scales from 1 µsec to 1 sec per division. Up to 30,000 divisions of offset permit small timing variations to be viewed on events with large average values.

TVC 501

REAL TIME

There is no resetting or re-arming. The continuous TVC output becomes another trace on your scope that can be correlated, measured, and analyzed with waveforms on other channels. Since the TVC generates voltages proportional to time-intervals, you can set your scope to trigger on timing violations such as a time-delay that exceeds a threshold or an incorrectly narrow pulse or glitch.

QUICK RESULTS

The TVC output is calibrated to drive any scope channel set to 100 mV per division. One key press can automatically set the trigger level or the measurement range. You can use the monitor output signal to verify that the TVC is measuring what you actually want it to measure. The TVC can also generate demonstration signals to quickly familiarize you with its operation.

FLEXIBLE CONFIGURATION

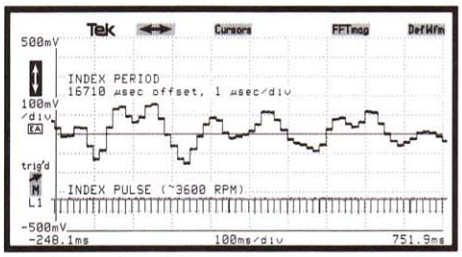
The TVC 501 can be used with other TM 500/5000 modular instruments in a suitable power module mainframe. See page 351.

APPLICATION INFORMATION

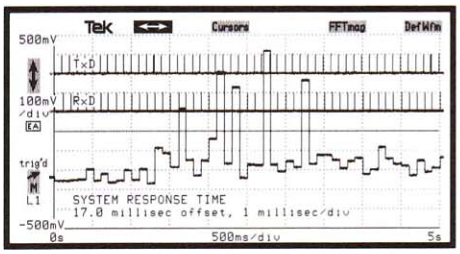
The TVC 501 Applications Brochure (60W-7869-00) includes a concept introduction and over 100 pages of application ideas that can help you apply the TVC. Several applications of the TVC 501 are illustrated in the following figures.

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

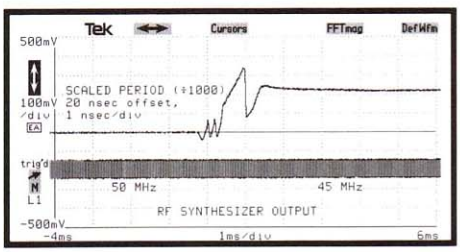
Instantaneous Time-Interval to Voltage Converter



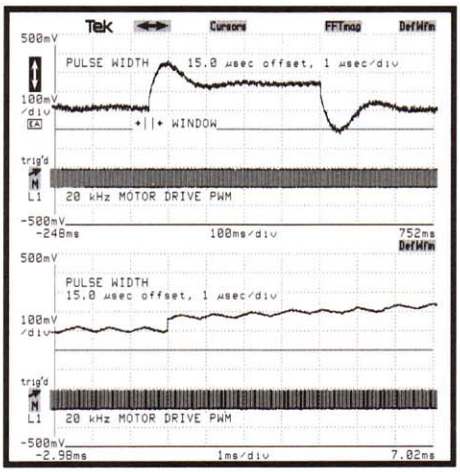
The lower signal shows the once per revolution disk drive index pulse. The TVC measures the pulse-to-pulse period variations and generates the upper waveform. The timing offset was set to 16710 µsec to show the ±2 µsec period variations.



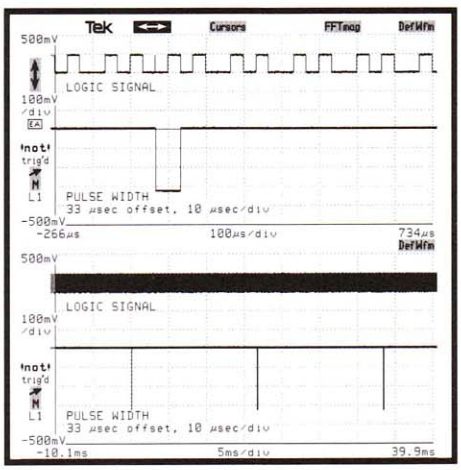
The upper two traces show the TxD and RxD signals on a terminal-mainframe RS-232 link. The TVC measures each delay between a character sent to the mainframe and the subsequent response. With an offset of 17 msec, the response time range was about 14-21 msec.



Using the built in prescaler, the TVC uncovers the ~3 msec settling interval of an RF synthesizer switching from 50 MHz to 45 MHz. The period shifts from 20.0 to 22.2 nsec.



The TVC shows the pulse width variations of a motor drive signal as the controller jogs the speed (upper screen). The 20 kHz PWM signal itself is a blur. On the lower screen the two signals are windowed around the transition. The TVC unveils an instantaneous step in pulse width as well as a pulse width oscillation.



The logic signal has a constant 33 µsec pulse width, but there is an occasional glitch. In the width mode, the TVC instantly responds to the glitch and recovers after the next pulse. Over a longer measurement interval (lower screen), the logic signal appears as a blur; the TVC shows that the glitch is periodic.

Characteristics

A AND B CHANNEL INPUTS (BNC)

Impedance – 1 MΩ, ≤50 pF.

Coupling – AC or DC selectable.

Trigger Slope – Rising or falling edge selectable.

Trigger Level – Adjustable in 10 mV steps in ±1.25 V window, 100 mV steps in ±12.5 V window when using 10X probes. Digital trigger level readout decodes Tektronix readout probes.

Sensitivity – ~10 nsec pulses at 250 mV.

TIMING MEASUREMENTS

Functions – A-Period, A-Width, A-to-B Delay.

Scope Viewing Range – ±4 divisions around Conversion Offset, out-of-range LED flags conversions outside of viewing range.

Conversion Offset – Adjustable to 30,000 divs in 0.1 div increments.

Conversion Scale – 1 µsec/div to 1 sec/div in 7 decade steps.

Best Timing Resolution – 33 nsec at 1 µsec scale (1/30th of a division).

Uninterrupted Rate – Up to 2.5 MHz (400 nsec between events), random sampling LED flags missed measurements.

MEASUREMENT OUTPUT (BNC)

Voltage Range – ±400 mV into 1 MΩ. Corresponds to ±4 vertical scope divisions when scope set to 100 mV/div. Automatically clips outside of ±4 division range.

Response Time – voltage settles <500 nsec after end of event.

A AND B MONITOR OUTPUTS (SMB)

Voltage Range – ~0-500 mV into 1 MΩ. Goes high when input meets trigger slope and level criteria.

B Monitor Prescaler – Can generate one pulse every 100 or every 1000 triggers to measure high frequency oscillators (>100 MHz).

B Monitor Demonstration – Can generate 5 different digital demonstration signals.

ORDERING INFORMATION

TVC 501

Instrument Module.....**$2,495**

Includes: 2 Monitor Cables; 1 Output Cable; 1 P6109 10X Readout Probe; Operator's Manual (070-7991-00); Service Manual (070-7992-00). Requires a TM 500/5000 Power Module. See page 351.

ADDITIONAL ACCESSORIES

Monitor cable – 42 in SMB-BNC Order 012-0532-00.....**$65**

Output cable – 42 in BNC-BNC Order 012-0057-01 .....**$28**

50 Ω BNC Feed Through Termination – Order 011-0049-01.....**$35**

P6408 16-bit Word Recognizer – Use the P6408 when time-intervals are defined by a bus address **$425**

P6420 RF Probe – 10 kHz-1 GHz. Demodulates RF bursts for pulsed RF timing measurements. **$200**

P6009 100X Readout Probe – Extends trigger voltage range to ±125V for high voltage pulses.....**$265**

See probes section for other readout probes and input terminations.

BNC Adapter – Converts P6109 Probe Tip to BNC male. Order 013-0084-01 .....**$14.25**

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

Differential Probes

Measure two voltage points in a circuit and provide as an output the difference between two voltages. Ideal for measuring read/write signals in disk drives, avoiding ground loop errors in mixed signal circuits and testing twisted pair data links.

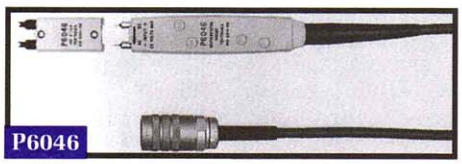
P6046

- Active Differential System
- DC to 100 MHz
- 1X/10X Differential
- Typically 20,000:1 CMRR derating to 2,000:1 at 50 MHz
- ±250 V Maximum Voltage with 10X Attenuator

Differential Measurements

Differential measurement systems enable you to simultaneously measure two voltage points in a circuit and provide as an output the difference between the two voltages.

Tektronix offers two types of differential measurement probes: the active differential probe system and the passive matched pair of probes. The P6046 is a 100 MHz active differential amplifier in probe form which connects to one channel of a standard scope amplifier. The P6135A ia a passive probe pair designed to enhance the performance of a differential amplifier.



P6046 with 10X Attenuator

P6046 ACTIVE DIFFERENTIAL PROBE SYSTEM

The P6046 is a self-contained active differential system consisting of a Differential Probe, Amplifier and Power Supply. Active FET amplifiers at the dual-inputs reduces circuit loading. Combined with the differential processing occurring in the probe head, the P6046 provides superior common mode rejection ratios (CMRR) at high frequencies typically 20,000: 1 out to 50 kHz, derating to 8,000:1 at 1 MHz.

Since the P6046 is self-contained, it provides a differential output into a single channel of any oscilloscope. System controls enable you to select AC or DC coupling, adjust the DC balance and select mV/Division from 1 to 200 mV (10 mV to 2 V with attenuator head) in standard 1, 2, 5 steps.

A slip-on 10X attenuator is also included which increases the maximum input voltage from ±25 V to ±250 V and the common mode dynamic range from ±5 V to ±50 V.

P6046 Amplifier with Power Supply

Characteristics

CMRR – With deflection factors of 1 to 20 mV/div: at least 10,000:1 at 50 kHz, 5,000:1 at 1 MHz, and 1,000:1 at 50 MHz (DC coupled).

Common Mode Linear Dynamic Range – ±5 V, ±50 V with 10X attenuator.

Bandwidth – DC to 100 MHz (– 3 dB).

Rise Time – 3.5 ns or less.

Deflection Factor Range – 1 to 200 mV/div in 8 calibrated steps, 1-2-5 sequence, accurate within 3% (with an oscilloscope deflection factor of 10 mV/div). Input RC 1 MΩ paralleled by 10 pF or less.

Input Coupling – AC or DC, selected by a switch on the probe. Low frequency response AC-coupled is – 3 dB at 20 Hz, 2 Hz with 10X attenuator.

Displayed Noise – Typically 450 mV or less (tangentially measured).

Maximum Input Voltage – ±25 V (DC + peak AC), ±250 V with 10X attenuation, derated with frequency. The P6046 circuitry can be damaged by electrostatic discharge. Please refer to the manual for use.

Output Impedance – 50 Ω through a BNC-connector. 50 Ω termination supplied with amplifier for use with 1 MΩ systems.

Probe Cable – 6 ft. long, terminated with special nine-pin connector.

TD

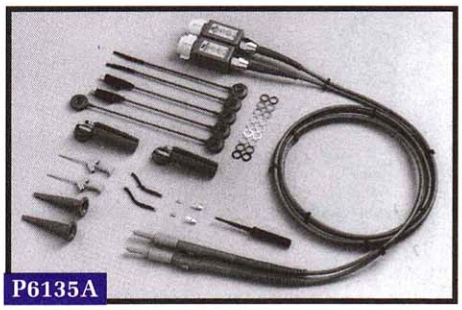
Product also available within 24 hours through TekDirect. Call 1-800-426-2200

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

ORDERING INFORMATION

P6046
1X, 6 ft. FET Differential Probe with Amplifier and Power Supply ..... TD **$2,195**
Includes: 50 Ω Termination (011-0049-01); Amp and Power Supply (015-0106-00); 50 Ω Coaxial Cable (012-0076-00); Hanger Assembly (014- 0029-00); Carrying Case (016-0111 01); 10X Attenuator (010-0361-00); Dual Attenuator Head (010-0419-00); Swivel Probe Tip; Spring Ground Contact; Connector Test Point Jack; Instruction Manual (070-7129-01).

Opt. A6 – Japan, 100 V, 50 Hz ..... **NC**
Power Supply with Amplifier. Order 015-0106-00 ..... **$1,335**



P6135A Differential Probe Pair

The P6135A 10X Differential Probe Pair is specifically designed to obtain the maximum in performance from a Tektronix differential measurement system. With differential amplifiers the P6135A provides CMRR ratios up to 20,000:1. Since a single 10X probe with accuracy of 1% or less gives a scope-to-probe CMRR of no better than 50:1, the P6135A is essential to obtain accurate results from your differential amplifier. Three pairs of carefully matched, precision-engineered hybrid tips enable the P6135A to be specifically matched with all Tektronix 11000, 7000 and 5000 Series differential amplifiers and comparators. It also provides excellent performance when used with plug-in amplifiers or oscilloscopes having input impedances of 1 MΩ/13-15 pF, 1 MΩ/18-22 pF and 1 MΩ/45-49 pF.

DIFFERENTIAL PROBE PAIRS

Differential probe pairs such as the P6135A are very carefully matched to minimize differences in capacitance and resistance (to minimize differences in impedance) and length (to minimize signal delay differences). Additionally the attenuation adjusts to compensate for any remaining differences in the probes as well as differences in the attenuation of the plug-in or scope amplifier.

DIFFERENTIAL AMPLIFIERS/ COMPARATORS AND THE P6135A

For high frequency applications, the P6135A with the 11A33 Differential Comparator provides a maximum bandwidth of 150 MHz and a minimum CMRR of 10,000:1 up to 1 kHz, decreasing to 100:1 at 20 MHz. For high CMRR measurements, the 7A13 Differential Amplifier and P6135A have a CMRR of 20,000:1 up to 1 kHz, decreasing to 100:1 at 20 MHz and a maximum bandwidth of 90 MHz. Combined with the TM 500 Series AM 502 Differential Amplifier, the P6135A provides 20,000:1 CMRR up to 1 MHz. An added benefit with the AM 502 is that the differential output can be connected to any oscilloscope for display.

Characteristics

CMRR – On 11A33: 10,000:1 from DC to 1 kHz, derating to 100:1 at 20 MHz. On 7000-Series: 20,000 to 1 from DC to 1 kHz derating to 100:1 at 20 MHz.

Attenuation – Adjustable to 10X.

Input Resistance – 1 MΩ.

Input Capitance – 10.5 pF on instrument with 15 pF input capitance; 11.0 pF when used with instrument that has 20 pF input capitance; 13.7 pF when used with instrument that has 47 pF input capitance.

Maximum Useful Bandwidth – On 11A33: DC to 150 MHz; On 7A13: DC >90 MHz.

Typical Probe Rise Time – On 11A33: <2.33 ns; On 7A13: <3.89 ns.

Maximum Common Mode Voltage – 500 V (DC + pk AC) from DC to 1.3 MHz, derated to 50 V (DC + pk AC) at 100 MHz.

For more information about the P6135A and differential measurements, request data sheet 63W-8103.

P6135A

- Attenuation Adjustable to 10X
- 10,000: 1 CMRR on 11A33 Differential Comparator; 20,000: 1 on 7A13 Differential Amplifier
- ±500 V Maximum Common Mode Voltage
- Matched Pair
- Applications
  - Power supplies
  - Disk Drives
  - Electric Ballast
  - Intelligent Motion
  - Single and Three Phase Adjustable Speed Drives

Specifically designed to obtain the maximum in performance from a Tektronix differential measurement system.

ORDERING INFORMATION

P6135A

Pair of 10X, 150 MHz Differential Probes **$695**

Includes: Adjustment Tool (003-1433-00); Two Retractable Hook Tips (013-107-06); Two Circuit Board Connectors; 6 in. Dual-ring Ground Lead (196-3295-00); Accessory Pouch (016-0708-00); Two 6 in. Ground Leads (196-3113-02); Two 6 in. Ground Leads with Alligator clips (196-3305-00); Two SMT KlipChip™ (206-0364-00); Two Low Inductance GND Collars (343-1003-01); Two Probe Tip Holders (352-0670-00); 2 in. Ground Leads (195-4240-00); Cable Marker Rings; Instruction Manual (070-7675-00).

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

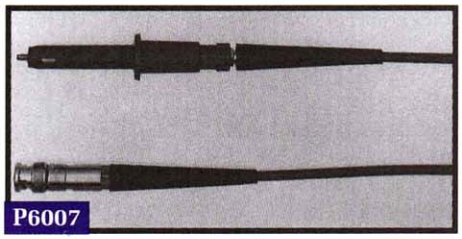
P6007
P6009

High Voltage Probes

Safe measurement of high voltage power supplies, industrial motors.

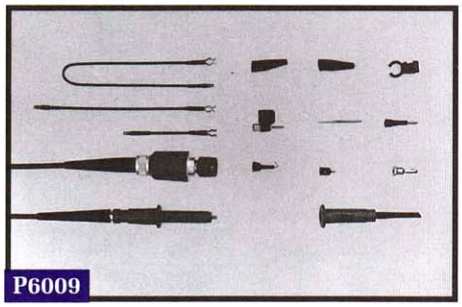
P6007
- DC to 25 MHz
- 100X
- 1500 VDC + Peak AC
- Low Capacitance – 2.0 pF

P6009
- DC to 120 MHz
- 100X with Readout
- 1500 VDC + Peak AC
- Low Capacitance – 2.5 pF


P6007

P6007

The P6007 is a low input capacitance, high-voltage (1.5 kV) probe. It can be compensated to match all plug-ins and oscilloscopes with nominal input capacitances of 8 to 55 pF and input resistance of 1 MΩ.


P6009

P6009

The P6009 is a low input capacitance, high-voltage (1.5 kV) probe designed for higher performance measurements. The probe can be compensated to match plug-ins and oscilloscopes with nominal input capacitances of 8 to 47 pF and input resistance of 1 MΩ.

The P6009 is equipped with a BNC connector that provides CRT Readout information when used with plug-in units and oscilloscopes that have these features.

Characteristics

	Nominal Length	Atten-uation	Band-width	Rise Time	Loading	Max Input V	Scope C In pF DC or RMS	Readout
P6007 Opt. 01	3.5 ft.	100X	25 MHz	14 ns	10 MΩ/2 pF	1.5 kV	8 to 55	No
P6007	6 ft.	100X	25 MHz	14 ns	10 MΩ/2.2 pF	1.5 kV	8 to 55	No
P6007 Opt. 03	9 ft.	100X	25 MHz	14 ns	10 MΩ/2.4 pF	1.5 kV	8 to 55	No
P6007 Opt. 04	12 ft.	100X	25 MHz	14 ns	10 MΩ/2.6 pF	1.5 kV	8 to 55	No
P6009	9 ft.	100X	120 MHz	2.9 ns	10 MΩ/2.5 pF	1.5 kV	8 to 49	Yes

TD
Product also available within 24 hours through TekDirect. Call 1-800-426-2200

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

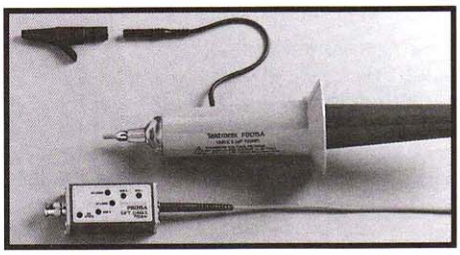
ORDERING INFORMATION

P6007
100X, 5 ft. High Voltage Probe ..... TD **$160**
Includes: Retractable Hook Tip (013-0071-00); Banana Tip (134-0013-00); 5 in. Ground Lead (175-0124-01); 12 in. Ground Lead (175-0125-01); .005 in. Diameter Straight Tip (206-0015-00); .080 in. Diameter Spring Tip (206-0060-00); Hook Tip (206-0105-00); 2 Miniature Alligator Clips (344-0046-00); Probe Holder (352-0090-00); Instruction Manual (070-0388-01).

Opt. 01 – 3.5 ft. Cable ..... **+$25**
Opt. 03 – 9 ft. Cable ..... **+$30**
Opt. 04 – 12 ft. cable ..... **+$35**

P6009
100X, 9 ft. High Voltage Probe with Readout ..... TD **$265**
Includes: Same as the P6607 plus Bayonet Ground Assembly (013-0052-00); 3 in. Ground Lead (175-0263-01); Instruction Manual (070-0401-01).

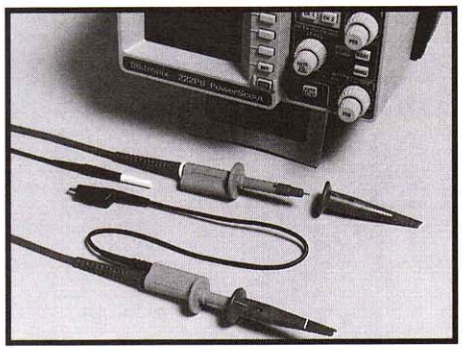
High Voltage Probes



P6015A High Voltage Probe

For heavy duty high performance measurements of voltages over 1.5 kV, the P6015A is the industry standard. You can measure DC voltages up to 20 kV and pulses up to 40 kV. The 75 MHz bandwidth enables you to capture fast, high-voltage signals. Although the CMRR is not as good as using the P6135A, two P6015As with a Tektronix differential amplifier provide a reasonable solution for higher voltage differential measurements.

The P6015A uses an environmentally safe silicone compound for a dielectric and never needs refilling. Other features include: a 7-49 pF compensation range, small compensation boxes which fit on adjacent amplifier inputs, and a readout option for use with Tektronix digital scopes. With the readout option, displayed voltage amplitude values will be the actual signal value rather than understated by a factor of 1,000. Using the readout version with other than Tektronix digital scopes may result in an erroneous readout display.



P850 and P400 with 222PS.

P400 and P850 Voltage Probes

The P400 and P850 are used with the 222A, 222PS, and 224 handheld oscilloscopes. These oscilloscopes feature two completely isolated floating input channels. The P400 and P850 are UL listed and were specifically designed for making safe power measurements. The P400 is 1X attenuation and the P850 is 10X attenuation. These probes directly plug into the 22X oscilloscopes and are only usable with them. Since the performance of the probes depend on which of the 22X oscilloscopes they are being used with, refer to the characteristics table for specific scope/probe specifications.

P6015A

- High Voltage – 20 kV DC/40 kV Peak (100 ms pulse width)
- High Bandwidth – 75 MHz
- Silicone Dielectric (No Freon)
- Optional 1,000X Coding
- Wide Compensation Range (7-49 pF)
- Heavy Duty Versatile Ground Lead and Clip

P850

- 10X
- DC to 60 MHz
- UL Listed

P400

- 1X
- DC to 20 MHz
- UL listed

P6015A

High voltage measurements for auto ignition, transformers, circuit breakers, surge protectors, lightning strike evaluation, avionics: radar, magnetrons, traveling wave tubes, electric ground transportation vehicles, semiconductor production equipment.

P400/P850

Safe power measurements for industrial service with 22X Handheld Oscilloscopes.

Characteristics

P6015A

	Nominal Length	Attenuation	Bandwidth	Rise Time	Loading	Max DC Input V	Scope C In pF	Readout
P6015A	10 ft.	1000X	75 MHz	4.0 ns	100 MΩ/3 pF	20 kV	7 to 49	No
P6015A Opt. 1R	10 ft.	1000X	75 MHz	4.0 ns	100 MΩ/3 pF	20 kV	7 to 49	Yes
P6015A Opt. 25	25 ft.	1000X	25 MHz	14 ns	100 MΩ/4 pF	20 kV	7 to 49	No
P6015 Opt. 2R	25 ft.	1000X	25 MHz	14 ns	100 MΩ/4 pF	20 kV	7 to 49	Yes

P850/P400

	Nominal Length	Attenuation	Loading	Bandwidth			Max Input V		
				222A	222PS	224	222A	222PS	224
P400	3.5 ft.	1X	1 MΩ/30 pF	10 MHz	10 MHz	20 MHz	400 V	850 V	850 V
P850*	3.5 ft.	10X	10 MΩ/4.5 pF	10 MHz	10 MHz	60 MHz	400 V	850 V	850 V

** The P850 is rated for 6 kV peak surge (≤250 µS) when used with the 222PS and 224, but not for the 222A.*

ORDERING INFORMATION

P6015A

100X, 10 ft. High Voltage Probe ..... TD **$895**

Includes: Alligator Clip – plugs onto Probe Tip (344-0005-00); Crocodile Clip – plugs onto Ground Lead (344-0461-00); Ground Lead (196-3363-00); Carrying Case (016-1147-00); Instruction Manual (070-8223-00).

Opt. 1R – 10 ft. with readout. ..... **+$55**

Opt. 25 – 25 ft. without readout. ..... **+$125**

Opt. 2R – 25 ft. with readout. ..... **+$170**

P850

10X, 3.5 ft. Voltage Probe **$100**

Includes: Ground Lead (196-3337-00); Accessory Kit (020-1908-00); Datasheet (063-0634-00).

P400

1X, 3.5 ft. Voltage Probe **$100**

Includes: Ground Lead (196-3337-00); Accessory Kit (020-1908-00); Datasheet (063-0634-00).

TD

P6015A also available within 24 hours through TekDirect. Call 1-800-426-2200

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

A6902B

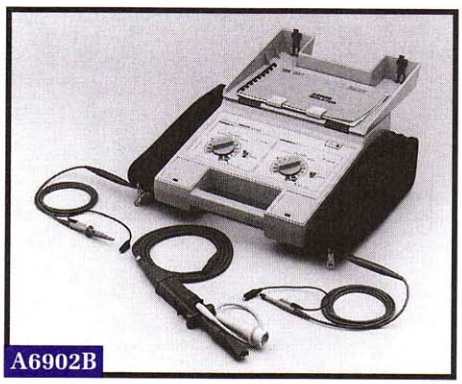
Voltage Isolator

A6902B provides safe floating power measurements for motor controllers, power supplies and power semiconductors.

A6902B

- For 50 Ω or 1 MΩ Inputs
- Two Independently Isolated Channels
- High Voltage
- UL Certified to 3000 V/Channel (6000 V Maximum Channel Differential)*1
- DC to 20 MHz Bandwidth

*1 *When ordered with Opt. 02 or 09.*



A6902B Voltage Isolation Amplifier

A dual-channel, optical- and transformer-coupled voltage isolator, the A6902B allows safely grounded test instruments to make floating measurements at high sensitivity levels in the presence of large common mode signals. Placed between your grounded test instrument and the circuit you are testing, it allows you to safely make floating measurements up to ±500 V (DC plus peak AC) with the small signal probes or ±3000 V (DC + peak AC) with the optional large probes. Both probes are quickly interchangeable at the cable connectors, and can be stored in convenient, removable side pouches.

Designed for use with any dual-channel oscilloscope, the A6902B permits simultaneous observation of two signals at two different points in the same circuit; or signals in two different circuits without respect to common lead voltages.

Separate, calibrated controls for volts per division on each channel allow precise floating measurements. The plastic case and external controls protect the user during control settings and other operations. Other than probe tip connection, the user is never in close proximity to hazardous voltages.

Characteristics

ELECTRICAL

Deflection Factor – Probe Tip Sensitivity: 20 mV/div to 500 V/div in 1-2-5 sequence with oscilloscope set to 100 mV/div. Accuracy: ≤5% of indicated V/div switch setting.

Frequency Response Bandwidth – DC coupled (to –3 dB point) is ≥20 MHz. AC coupled (to lower –3 dB point) is ≤5 Hz to ≥20 MHz (50 to 500 V/div not specified).

Transient Response – Rise time ≤17.5 ns.

Maximum Working Voltage:
Small Probe (500 V) – Probe Center Tip to Earth Ground: 500 V (DC + peak AC). Probe Center Tip to Probe Common: 500 V (DC + peak AC) to 3 MHz. Maximum voltage derates above 3 MHz. Probe Common to Earth Ground: 500 V (DC + peak AC) to 6 MHz. Maximum voltage derates above 6 MHz.

Large Probe (AC Coupled) – Probe Center Tip to Earth Ground: 500 V (DC + peak AC).

Large Probe (DC Coupled) – Probe Center Tip to Earth Ground: UL 3000 V. Probe Center Tip to Probe Common: UL 3000 V (DC + peak AC) to 450 kHz. Maximum voltage derates above 450 kHz. Probe Common to Earth Ground: UL 3000 V (DC + peak AC) to 250 kHz. Maximum voltage derates above 250 kHz.

Maximum Input dV/dt – 100 V/ns.

Input Impedance – Resistance: 10 MΩ ±3%.

Capacitance – ≈ 19 pF with either probe.

Output Impedance – 50 Ω ±5%.

Output Drive – 4 Vp-p into 1 MΩ.

Common-Mode Capacitance – 100 pF from probe common to earth ground.

Max Common to Ground Slew Rate – 500 V/µs.

Tangential Noise – ≤20 mV.

DC Drift with Temperature – ≤10 mV/°C or 0.1 div/°C at output.

Range of Output DC Level – At least +5 div from center screen.

Channel Isolation – Maximum Voltage: Using two 3,000 V UL probes is 6000 V (DC + peak AC) UL. Using two 500 V probes is 1000 V (DC + peak AC).

Delay – 51 ns ±3 ns (large probe), 52 ns ±3 ns (small probe), from probe input to instrument input. CH 1, CH 2 delay difference is ≤4 ns.

Common Lead Signal Feedthrough – –106 dB from probe input to output BNC to 500 Hz. Derated above 500 Hz.

POWER REQUIREMENTS

Line Voltage Ranges – Low: 90 to 132 V. High: 180 to 250 V.

Line Frequency Range – 48 to 440 Hz.

Maximum Power Consumption – 24 W at 115 V, 60 Hz.

ORDERING INFORMATION

A6902B
Voltage Isolator (500 V Max) **$2,300**
Includes: Two 500 V Isolation Probes (010-0411-15); Right Angle Power Cord (161-0104-00); 98 in (249 cm), 50 Ω Output Cables (012-0204-00); Operator Manual (070-5614-01).

Opt. 02*1 – Add two Large Probes (010-0409-01) ..... **+$660**

Opt. 09*1 – Add two Large Probes plus two 4 mm Banana Adapters ..... **+$760**

Service Manual – Order 070-5615-01 ..... **$24**

INTERNATIONAL POWER PLUG OPTIONS

Opt. A1 – Universal Euro 220 V, 50 Hz ..... **NC**

Opt. A2 – UK 240 V, 50 Hz. ..... **NC**

Opt. A3 – Australian 240 V, 50 Hz ..... **NC**

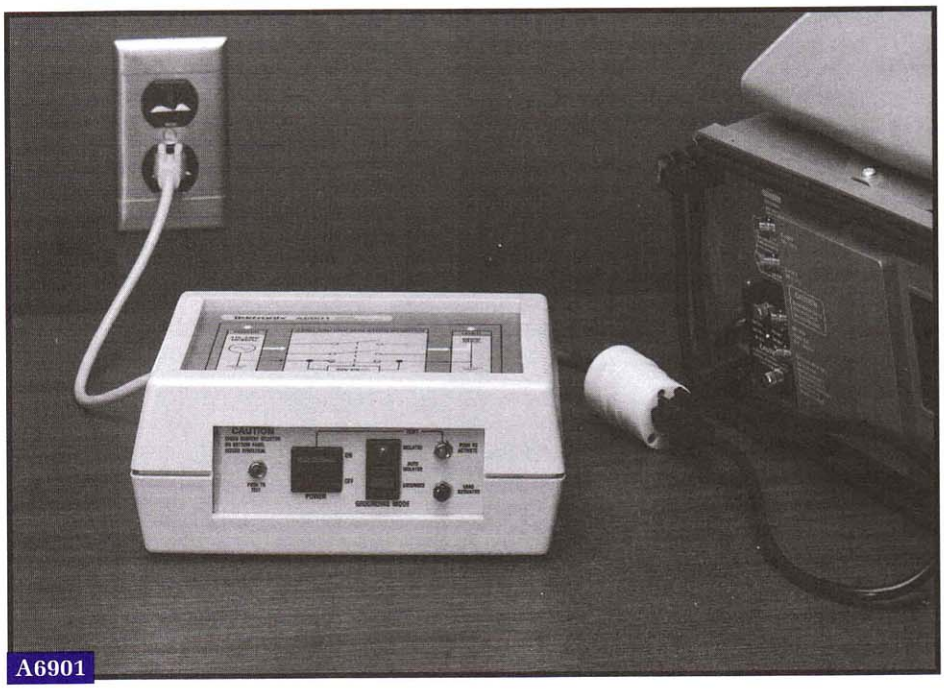
Opt. A4 – North American 240 V, 60 Hz ..... **NC**

Opt. A5 – Switzerland 220 V, 50 Hz ..... **NC**

*1 *Extends range to 3,000 volts per channel.*

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

Voltage Isolator



A6901

A6901

- Permits Elevation of Test Instrument Chassis to 40 V Peak (28 V RMS)
- UL and VDE Safety Certification

The A6001 provides a convenient and safe way to float your measurement instrument up to 40 Volts. Protects from electric shock and enables accurate logic level measurements and eliminates ground loop noise.

A6901 Ground Isolation Monitor

Placed between a measurement instrument and its power source, the A6901 Ground Isolation Monitor acts as an indirect grounding device, allowing floating measurements to be made with operator protection.

The A6901 monitors the voltage on the isolated system. When the voltage exceeds 40 V peak (28 V RMS) the power source to the instrument is interrupted, the isolated grounding system is connected to the power source grounding system, and an audible alarm is sounded. Before power is supplied to the measurement instrument, the A6901 tests the power source for a functional ground*[1]. If a functional ground is not established, the ground isolation monitor will not go into isolated mode.

Characteristics

ELECTRICAL

Trip Voltage (DC) – 40 V peak (28 V RMS) or ±40 V (within 5%).

Trip Current – 0.5 mA, 3.5 to 5 mA selectable.

Neutral-to-Ground Continuity – Between 3 and 10 V RMS (8.5 and 28.3 Vp-p), 50 Hz.

DC Voltage Trip Delay – < 20 ms.

Line Voltage Ranges – 90 to 128 V RMS, 180 to 250 V RMS.

Line Frequency Range – 48 to 66 Hz.

Maximum Power Consumption (No External Load) – 12 W at 115 V, 60 Hz.

Load Power – 500 W maximum.

[1] If the A6901 is used in conjunction with a GFI (Ground Fault Indicator), consult the GFI manual for compatibility information.

ORDERING INFORMATION

A6901
Ground Isolation Monitor **$1,800**
Includes: Operator Manual (070-3618-00).

INTERNATIONAL POWER PLUG OPTIONS
Opt. A1 – Universal Euro 220 V, 50 Hz ..... **NC**
Opt. A2 – UK 240 V, 50 Hz ..... **NC**
Opt. A3 – Australian 240 V, 50 Hz ..... **NC**
Opt. A5 – Switzerland 220 V, 50 Hz ..... **NC**

Opt. A4, North American 240 V not available due to lack of a grounded neutral connection in the 240 V North American system.

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

Voltage Isolator

Floating Measurements

Oscilloscope users often have to make floating measurements where neither point of the measurement is at ground (earth potential). Signal "common" may be elevated to hundreds of volts from ground. In addition, many of these measurements require the rejection of high common mode signals in order to evaluate low level signals riding on them. Extraneous ground currents can also add hum and ground loops to the display. Too often, these problems force users into using dangerous measurements techniques.

For safe operation and accurate operation, an oscilloscope must be referenced to ground. "Floating" a scope by defeating the scope's protective grounding system not only presents a danger to the operator because of high voltage shock hazard on the entire scope, but also stresses the scope's power transformer insulation. Common ways of defeating the scope ground are; non monitored isolation transformers, double insulated mains, isolating circuits and the traditional cutting off the ground prong or using a 3-to-2 wire adapter. All of these are dangerous!

Fortunately, there are several solutions available which are not only safe but much more accurate than the dangerous procedures. These fall into four general categories: Isolation Amplifiers, Indirect Grounding, Differential Measurement Systems and Isolated Input Oscilloscopes.

ISOLATION AMPLIFIERS

An isolating amplifier is connected between the circuit and the oscilloscope. The signal is coupled across an isolation barrier. The dual-channel A6902B is in this category and is rated for up to 3,000 V.

INDIRECT GROUNDING

An indirect grounding device is connected between the scope and the power mains. The A6901 Ground Isolation Monitor allows a scope to float up to a safe level of 40 V and immediately reconnects to ground when the voltage exceeds this level.

DIFFERENTIAL MEASUREMENT SYSTEMS

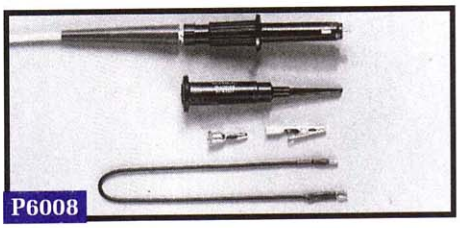
Differential voltage measurements can be made with high accuracy with the P6046 up to ±20 V, and up to ±500 V with a P6135A Differential Probe Pair and a differential amplifier such as the 11A33.

ISOLATED INPUT OSCILLOSCOPES

THE 222PS/224 hand held oscilloscopes feature dual input channels, individually isolated from the scope's chassis as well as from each other. With the 850 V rated P400 and P850 probes floating measurements can be made safely and accurately.

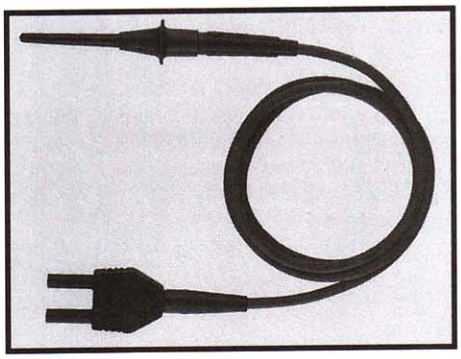
For more information, request Application Note Floating Oscilloscope Measurements... And Operator Protection, 60W-8535-0.

Specialty Probes



P6008 Environmental Probe

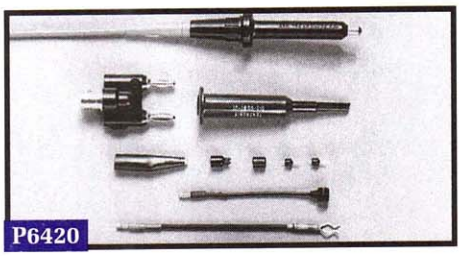
The P6008 Environmental Probe operates over –50°C to +150°C for the probe body and cable; the compensation box operates from –15°C to +55°C. The P6008 is compatible with the #6-32 screw-tip accessories.



For DMM Input

The P6602 is a temperature-measuring device designed to operate with the DM504A, DM5110 and DM511 Digital Multimeters, or with the 2236A oscilloscope and the 2445B, 2455B, and 2465B with DMM. The temperature-sensing element consists of a thin-film platinum resistor on the tip of the probe. Measurements are made by touching the probe tip to the test surface. The thermal signal is transmitted to the associated digital multimeter through a two-conductor cable.

The probes are totally immersible except in liquids that are incompatible with Polyetheretherketone (PEEK) compounds. The sensor, tip, and cable are limited to a maximum of 240°C.



P6420

The P6420 radio frequency (RF) probe measures high frequency AC voltage from 10 kHz to 1 GHz. It provides a DC output voltage proportional to the RMS value of a sine-wave input. It can be used with a DMM; or with an oscilloscope for RF envelope analysis.

P6008

- –50°C to +150°C Temperature Range
- 100 MHz, Environmental

P6420

- RF Probe
- 10 kHz to 1 GHz Bandwidth
- Voltage Range 0.5 to 25 V rms (70.7 Vp-p)
- For DMM or Oscilloscope

P6602

- Temperature measurements from –62°C to 240°C
- Use with TM500/5000 and Tektronix Oscilloscope DMMs

The P6008 provides voltage measurements in extreme environments.

The P6420 is ideal for transmitter or receiver design, RF power measurement and RF demodulation testing.

The P6602 provides circuit board thermal analysis, heat sink evaluation, and hot spot detection.

Characteristics

Probe Type	Nominal Length	Attenuation	Bandwidth	Rise Time	Loading Input R/C	Max V (DC + pk AC)	Instrument Input R/C
P6008	6 ft	10X	100 MHz	3.5 ns	10 MΩ/7.5 pF	600 V	1 MΩ/12-47 pF
P6420	2 m	N/A	10 kHz to 1 GHz	N/A	10 MΩ/3.7 pF	42.2 V	10 MΩ DMM

ORDERING INFORMATION

P6008
100 MHz Environmental Probe **$395**
Includes: Retractable Hook Tip (013-0071-01); Banana Tip (134-0013-00); 12 in. Ground Lead (175-0125-01); Alligator Clip (344-0045-00); Probe Holder (352-0090-00); Instruction Sheet.

P6602
1.5 m Temperature Probe **$335**
Includes: Instruction Manual (070-4038-00).

P6420
2 m RF DMM Probe **$200**
Includes: Retractable Probe Tip (013-0097-01); Two Alligator Clips (344-0046-00); Two Replaceable Probe Tips; Insulating Ground Cover (166-0404-01); 3 in. Ground Lead (175-0849-00); 6 in. Ground Lead (175-1017-00); Probe Holder (352-0351-00); BNC Female to Dual Banana Adapter (103-0090-00); Data Sheet.

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

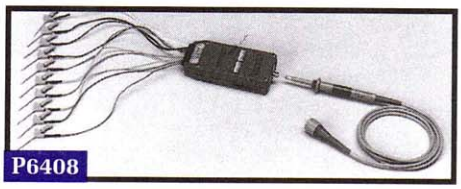
P6407
P6408

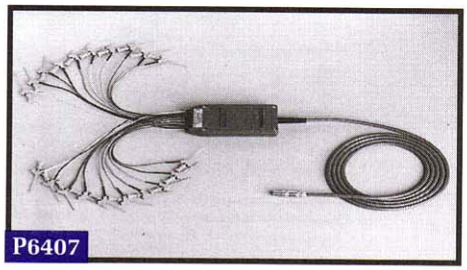
Word Recognizer Trigger Probes

Oscilloscope triggering on user-defined logic states.

P6407/P6408

- For TTL and TTL-Compatible Logic
- 17 Bits (16 Data Bits Plus Qualifier)
- Synchronous and Asynchronous Operation
- Easy to Use
- Simplifies Digital Troubleshooting and Debug
- P6407 – Use with 2400-Series Oscilloscopes
- P6408 – Use with any Oscilloscope


P6408


P6407

P6407/P6408

The P6407 and P6408 are 16 bit word recognizer trigger probes for use with analog and digital storage oscilloscopes. They allow the oscilloscope to trigger on user-defined logic states (rather than on analog levels), thus extending the utility of the oscilloscope into digital troubleshooting and debug applications.

The P6407 is available as an option to 2400-Series oscilloscopes and may be field-added to 2400-Series digital storage oscilloscopes. The trigger word is programmed from the oscilloscope's front panel.

The P6408 may also be used with oscilloscopes with 15 to 35 pF inputs when used with the P6109B probe or other probes which have a miniature size probe tip. The P6408 trigger word is manually programmed via miniature DIP switches on the probe pod. The P6408 derives its operating power from the device under test + 5 V bus.

The P6408 can be used with the TVC 501 to detect interrupt response faults, monitor subroutine timing, or verify PWM digital generation in embedded processor applications. Refer to the TVC 501 Applications Brochure (60W-7869) for further information.

Characteristics

	P6407	P6408
Input Channels – Data (Clock/Qualifier)/Power (Ground)	16 (2)/(2)	16 (1)/1 (2)
Input Logic Level – HI (ONE)/LO (ZERO)	≥ 2.0 V / ≤ 0.6 V	≥ 2.0 V / ≤ 0.7 V
Input Loading Current – HI (ONE) – LO (Zero)	20 mA max @ 2.5 V –600 mA max @ 0.5 V	20 mA max @ 2.7 V –600 mA max @ 0.5 V
Maximum Input Voltage Swing	–0.5 V to ≤ 5.5 V	0 V to ≤ Vcc
Max Non-destructive Input Voltage	–0.7 V to 5.5 V	–1 V (LO) to +15 V (HI)
Word Recognizer Output Level – HI (ONE)/LO (ZERO)	≥ 2.0 V/≤ 0.5 V	≥ 200 mV/≤ 70 mV
Asynchronous Mode		
Maximum Trigger Frequency	10 MHz	20 MHz
Minimum Coincidence Between Data Inputs Resulting in a Trigger	85 ns	40 ns
Max Coincidence Between any Two Data Inputs Without Producing a Trigger	20 ns	40 ns
Delay of Input Word Coincidence to Word Out	≤140 ns	20 ns
Synchronous Mode		
Data Setup Time	25 ns	
Data Hold Time	0 ns	
Minimum Clock Pulse Width High / Low	20 ns / 20 ns	
Minimum Clock Period	50 ns	
Delay of Selected Clock Edge to Word Out	≤ 55 ns	
Power Requirements	Provided by Host 2400 Series Instrument	+5 V ±0.25 V 100 mA max.
Recommended Instrument	2400 Series with Word Recognizer Option	Any instrumentation with 8 to 35 pF inputs.

TD
P6408 also available within 24 hours through TekDirect. Call 1-800-426-2200

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

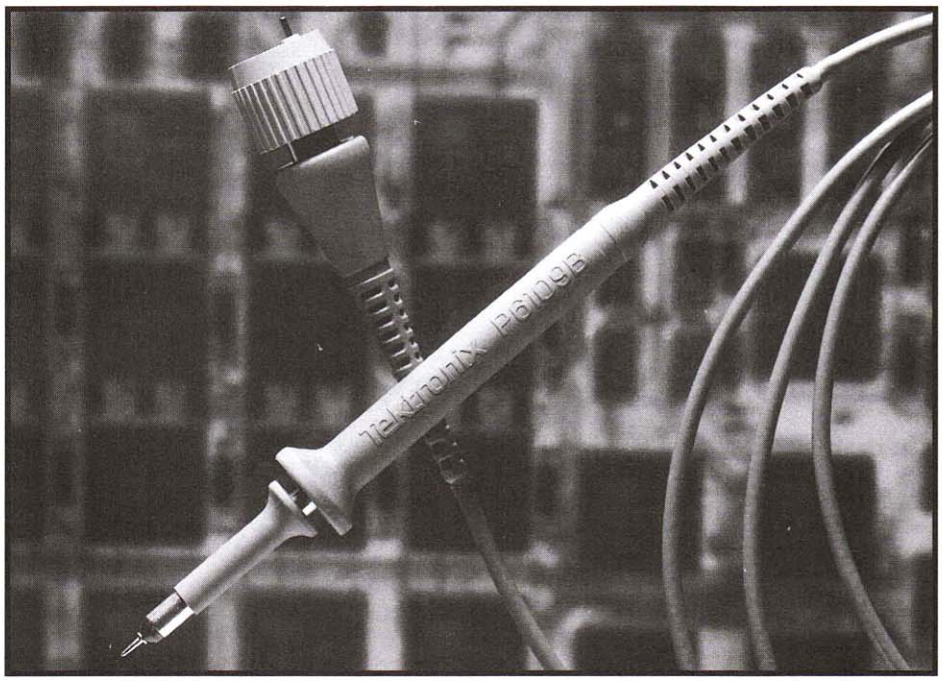
ORDERING INFORMATION

P6407
Word Recognizer/Trigger Probe.....**$600**
Includes: Two (10 wide) Lead Headers (012-0747-01); Pkg. of 20 SMT KlipChip™ Adapters (SMG50); Instruction Sheet (070-5582-00).

P6408
Word Recognizer/Trigger Probe..... TD **$425**
Includes: Two (10 wide) Lead Headers (012-0747-01); Pkg. of 20 SMT KlipChip™ Adapters (SMG50); P6109B Probe (complete package); Instruction Sheet (070-6938-00).

ADDITIONAL ACCESSORY
Probe Power Cable – Order 174-1342-00.....**$54**
Used with 1101A Power Supply.

Passive Voltage Probes



PASSIVE VOLTAGE PROBES

General purpose probes for Tektronix Oscilloscopes, Portables, the Classics, TDS, and TAS.

Tips on Selecting Probes

Nearly all general purpose and laboratory oscilloscopes use probes to make a direct, flexible and convenient connection to a device-under-test (DUT). Of all the different types of measurements, voltage measurements top the list by a wide margin. The ideal probe/oscilloscope combination should acquire the signal and truly represent it on the display without changing the signal source.

What to Consider When Selecting Probes

YOUR SCOPE'S . . .

- **Bandwidth?** Select a probe with equal or better bandwidth.
- **Input capacitance?** Select a probe with a compensation range covering the scope's nominal input capacitance.
- **Readout feature support?** Select a probe that provides automatic coding for scale factor.
- **Input loading?** Standard passive probes support 1 MΩ inputs. 50 Ω probes are also available in passive and active (FET) styles. (See pages 428).

YOUR APPLICATION . . .

- **Engineering and design –** High frequency, specialty, absolute measurements.
- **Service –** Mixture of high and low frequency, specialty and general purpose, absolute and relative measurements.
- **Manufacturing –** Low frequency, general purpose, relative measurements.

YOUR MEASUREMENTS . . .

- **How will probe loading affect your measurements?** High resistance probes (10 MΩ) give minimum amplitude error; however, any significant tip capacitance will degrade the leading edge.
- **What is the waveform risetime?** Passive probes work in conjunction with the scope's input circuitry to provide a system bandwidth.
- **What is the peak voltage?** Passive probes typically have 500 V peaks. High voltage probes can handle 2 kV to 40 kV.
- **What is the waveform amplitude?** Maximum input voltage for a passive probe is stated as DC pulse peak AC. This is also the maximum safe input before electrical damage occurs.

YOUR MECHANICAL REQUIREMENTS...

- **Probe size?** Small probes are easier to handle and attach to test points. Larger probes are more durable.
- **Tip type?** Probe tip durability is affected by materials and design. Tektronix's most durable configuration for passive voltage probes is the miniature type which is supported by a wide variety of tip accessories for test point connection. The compact probe configuration offers improved electrical performance. Subminiature probe types are useful for probing high density circuitry where several probe have to attached in close proximity.
- **Environmental conditions?** Probes are expected to be exposed to harsh conditions in the field, but often over looked are the rigors of daily use and abuse that general purpose probes are most likely to experience.

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

P6101B
P6103B
P6109B
P6119B
P6129B

Passive Voltage Probes

B-Series 1 MΩ Inputs

Guaranteed compatibility & performance with Tektronix portable oscilloscopes.

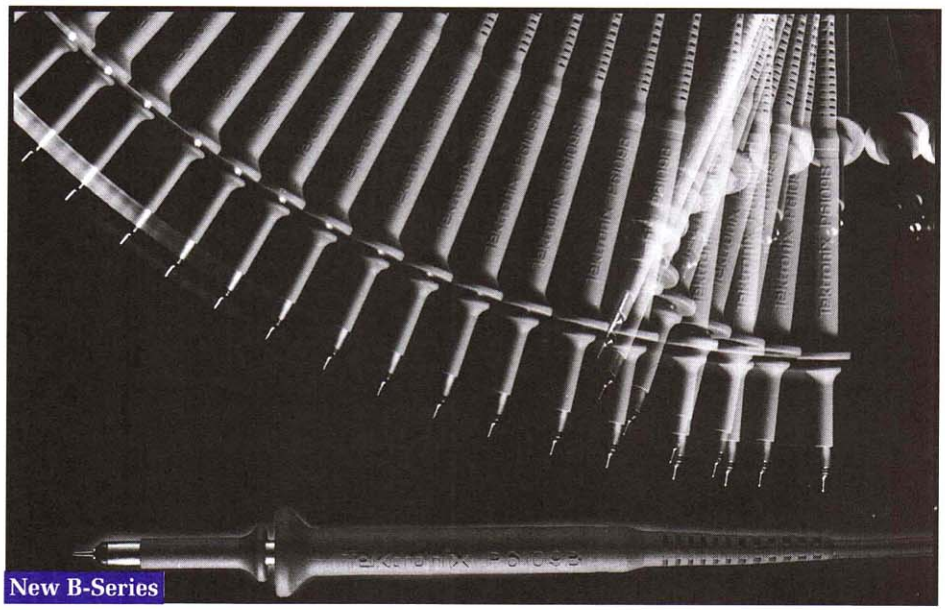
P6101B
- 1X, 15 MHz

P6103B
- 10X, 60 MHz

P6109B
- 10X, 100 MHz
- Readout

P6119B
- 1X, 10 MHz
- 10X, 100 MHZ

P6129B
- 1X, 10 MHz
- 10X, 100 MHz
- Readout

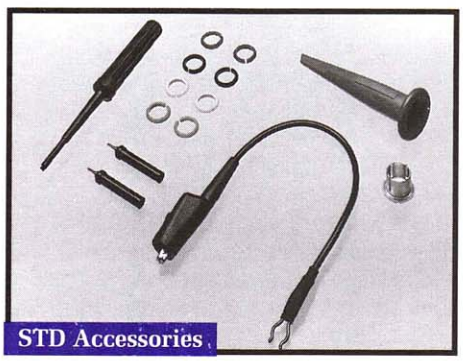


B-Series Family Photo

B-Series Passive Voltage Probes

- Single piece, molded rubber body.
- Light weight ergonomic design.
- 10 times improvement in durability.
- HYBRID/SMT circuitry on multi-layer circuit board for improved performance and reliability.
- New stronger replaceable probe tip.
- UL safety certification.
- 1 year unconditional guarantee.
- Miniature probe tip compatible with a wide range of Tektronix accessories and adapters.

Passive voltage probes are the most commonly used oscilloscope probe. Other specialty probes expand the range and functionality of an oscilloscope as a measurement system, but a general purpose, passive voltage probe is the working end of the oscilloscope, a tool used and abused every day without concern by engineers and technicians. The probe's utility is often taken for granted...that is until it doesn't work. And then it's a scramble just to complete the simplest task.



Two years of customer research, design innovation, and an exhaustive test program resulted in a most remarkable family of oscilloscope probes. The B-series of passive voltage probes are specifically designed for Tektronix' analog and digital portable oscilloscopes. The 1X, 10X and 1X/10X switchable probes combine the same high quality electrical performance that customers expect from Tektronix with a new rugged mechanical design.

A B-series probe is encased in a resilient, molded rubber body and is virtually indestructible. It is lighter weight, more comfortable to hold, and more reliable than modular probe styles. The probe's replaceable tip is designed to withstand up to 20 pounds of force. Patented integral strain relief allows complete freedom of movement while providing superior cable flex. Each probe has received UL safety certification and meets Mil-T-28800, Class 3, environment specifications – something portable scope users will appreciate.

The P6101B, P6103B, P6109B, P6119B and P6129B probes are designed to complement Tektronix' family of portable DSO and ART instruments. The core of each probe's performance is supplied by a Tektronix' HYBRID/SMT device. Tektronix' instrumentation experience provides an extra margin of quality and reliability to the B-series that is not commonly available to probe manufacturers. B-series probes have been designed and tested to support the overall system performance and measurement quality that Tektronix oscilloscope's guarantee.

Through the introduction of the B-series, Tektronix has set a new standard for passive voltage probe styling, performance and durability.

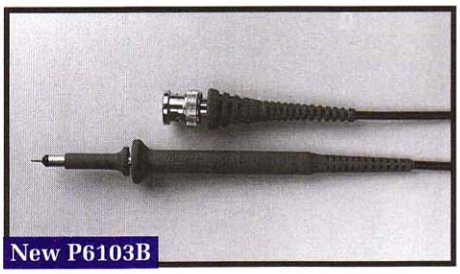
TD
Product also available within 24 hours through TekDirect. Call 1-800-426-2200

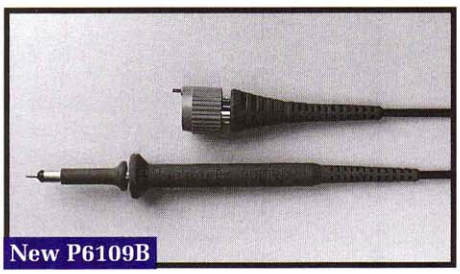
To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

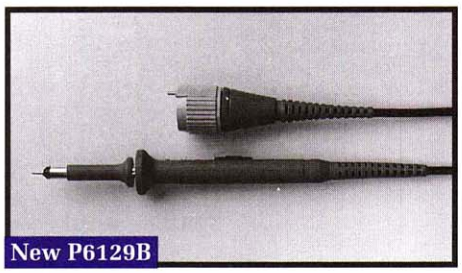
Passive Voltage Probes

B-Series 1 MΩ Inputs

P6101B **P6103B** **P6109B** **P6119B** **P6129B**







P6101B
- 1X Attenuation
- 15 MHz Bandwidth

Compatible with All Scope Series

P6103B
- 10X Attenuation
- 60 MHz Bandwidth

Scope Compatibility: 2201, 2205, 2212, 2214, and 2225

P6109B
- 10X Attenuation
- 100 MHz Bandwidth
- Supports Readout Function

Scope Compatibility: 2211, 2221, 2224, 2230, 2232, 2235A, 2236A, 2245A, 2246A, 2247A, and 2252

P6119B
- 1X/10X Switchable Attenuation
- 10/100 MHz Bandwidths

Scope Compatibility: 2201, 2205, 2212, 2214, and 2225

P6129B
- 1X/10X Switchable Attenuation.
- 10/100 MHz Bandwidths.
- Supports Readout Function.

Scope Compatibility: 2211, 2221, 2224, 2230, 2232, 2235A, 2236A, 2245A, 2246A, 2247A, 2225, TAS 455, TAS 465.

PROBE SPECIFICATIONS CHART

Type	Attenuation	Bandwidth Mega Hertz (MHz)	Comp. Range pico Farads (pF)	System Input Resistance Mega Ohms (MΩ)	Typical Input C pico Farads (pF)	Maximum Voltage DC+pk AC (Volts)	Read Out
P6101B	1X	15	NA	1	100	420	
P6103B	10X	60	15 to 35	10	13	420	
P6109B	10X	100	15 to 35	10	13	420	√
P6119B	1X/10X	10/100	15 to 35	1/10	100/18	420	
P6129B	1X/10X	10/100	15 to 35	1/10	100/18	420	√

All probe cables are 2 meters.

ORDERING INFORMATION

P6101B
1X, 15 MHz Passive Voltage Probe ..... TD **$60**
Includes: 4 pairs of Colored Cable Markers; Retractable Hook Tip; 6 in. Ground Lead; 2 replacement Probe Tips; Adjustment Tool; Storage Pouch; Instruction Manual (070-7819-00).

P6103B
10X, 60 MHz Passive Voltage Probe ..... TD **$50**
Includes: 4 pairs of Colored Cable Markers; Retractable Hook Tip; 6 in. Ground Lead; 2 replacement Probe Tips; Adjustment Tool; Storage Pouch; Instruction Manual (070-7847-00).

P6109B
10X, 100 MHz Passive Voltage Probe with readout ..... TD **$70**
Includes: 4 pairs of Colored Cable Markers; Retractable Hook Tip; 6 in. Ground Lead; 2 replacement Probe Tips; an Adjustment Tool; Storage Pouch; Instruction Manual (070-7849-00).

P6119B
1X/10X, 10/100 MHz Passive Voltage Probe ..... TD **$75**
Includes: 4 pairs of Colored Cable Markers; Retractable Hook Tip; 6 in. Ground Lead; 2 replacement Probe Tips; Adjustment Tool; Storage Pouch; Instruction Manual (070-8547-00).

P6129B
1X/10X, 10/100 MHz Passive Voltage Probe with readout..... TD **$95**
Includes: 4 pairs of Colored Cable Markers; Retractable Hook Tip; 6 in. Ground Lead; 2 replacement Probe Tips; Adjustment Tool; Storage Pouch; Instruction Manual (070-8000-00).

TD
Product also available within 24 hours through TekDirect. Call 1-800-426-2200

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

P6006
P6053C
P6062B/3B
P6122

P6102A
P6105A/6A
P6108A
P6149A

Passive Voltage Probes

For the Classic Oscilloscopes

For the classic oscilloscopes.

P6006
- 10X, 25 MHz

P6053C
- 10X, 250 MHz

P6062B
- 10X, 100 MHz

P6063B
- 10X, 200 MHz

P6102A
- 10X, 60 MHz

P6105A
- 10X, 100 MHz

P6106A
- 10X, 250 MHz

P6108A
- 10X, 100 MHz

P6122
- 10X, 100 MHz

P6149A
- 10X, 50 MHz

TD

P6062B, P6063B, P6105A, P6106A and P6122 also available within 24 hours through TekDirect. Call 1-800-426-2200

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

Modular Probes

During our first 40 years, Tektronix introduced many innovative oscilloscopes which established the standards for form and function that are still followed today. Technological gains have allow performance improvements over time, but the basic look and feel establish by Tektronix remains. Because of this, Tektronix scopes 10 and even 20 years old are still being used. We call these the Classics. Some of these older instruments have special probe requirements. The passive voltage probes found on these pages are for oscilloscopes introduced prior to 1986.

Tektronix modular probes are designed to save you money in repair and maintenance over the life of the probe. The three modules, probe head, cable and connector, quickly snap or screw together eliminating the need for soldering. Spare modules can be ordered and stocked, reducing down-time and eliminating the need to send a probe in for repairs. Modularity, rugged construction and highly reliable hybrid circuitry make these Tektronix probes a cost effective probing solution.

Tektronix modular passive probes are used to acquire high fidelity signals from low source impedance circuits. Each probe, except the P6108A, will automatically scale the readings on oscilloscopes equipped with the readout feature. Additionally these same probes provide a ground reference button on the probe head for quick trace identification.

P6102A
- 10X Attenuation
- 60 MHz Bandwidth
- Readout

Scope Compatibility: 5A14, 5A15, 5A18, 5A21, 5A22, 5A26, 7A19, SC501, SC502, and SC503

P6105A
- 10X Attenuation
- 100 MHz Bandwidth
- Readout

Scope Compatibility: 434, 455, 464, 464M, 465, 466, 468, 475, 485, 7A16, and SC504

P6108A
- 10X Attenuation
- 100 MHz Bandwidth

Scope Compatibility: T900 Series

P6062B
- 1X/10X Attenuation
- 100 MHz Bandwidth
- Readout

Scope Compatibility: 300 Series, 400 Series, 5000 Series, TM500/5000 Series, 7A19, 7D20, and 7L5

P6106A

P6106A
- 10X Attenuation
- 250 MHz Bandwidth
- Readout

Scope Compatibility: 475, 485, DC503A, DC5009, and DC5010

P6063B
- 1X/10X Attenuation
- 200 MHz Bandwidth
- Readout

Scope Compatibility: 400 Series, 7A13, 7A15A, and 7A26

P6122
- 10X Attenuation
- 100 MHz Bandwidth

Scope Compatibility: 2201, 2205, 2212, 2214, and 2225.

P6149A
- 10X Attenuation
- 50 MHz Bandwidth
- Right Angled BNC connector

Scope Compatibility: 305, 314-336

P6053C
- 10X Attenuation
- 250 MHz Bandwidth
- Compact probe tip
- Readout

Scope Compatibility: 7D20

P6006
- 10X Attenuation
- 25 MHz Bandwidth
- Rugged Body

Scope Compatibility: 5A14N, 5A15N, 5A18N, and SC501/2/3

Passive Voltage Probes

For the Classic Oscilloscopes

P6006	P6102A
P6053C	P6105A/6A
P6062B/3B	P6108A
P6122	P6149A

PROBE SPECIFICATIONS CHART

Type	Cable Length meters (m)	Attenuation	Bandwidth Mega Hertz (MHz)	Comp. Range pico Farads (pF)	System Input Resistance Mega Ohms (MΩ)	Typical Input C pico Farads (pF)	Ground Reference	Read Out
P6006	2	10X	25	15 to 55	10	8.5		
Opt. 03	3		25			11		
Opt. 04	4		12			15		
P6053C	2	10X	250	15 to 35	10	12.5		√
Opt. 01	1.5		250			9.5		
Opt. 03	3		250			13.5		
P6062B	2	1X/10X	6.5/100	15 to 47	1/10	14/105	√	√
Opt. 01	1.5		8/100			13/100		
Opt. 03	3		4.5/100			17/135		
P6063B	2	1X/10X	6/200	15 to 24	1/10	14/105	√	√
Opt. 01	1.5		12/200			11/80		
P6102A	2	10X	60	15 to 35	10	13	√	√
P6105A	2	10X	100	15 to 35	10	11	√	√
Opt. 01	1		100			9		
Opt. 03	3		90			13		
P6106A	2	10X	250	15 to 35	10	11	√	√
Opt. 01	1		250			9		
Opt. 03	3		150			13		
P6108A	2	10X	200	15 to 35	10	11		
Opt. 01	1		100			9		
Opt. 03	3		90			13		
P6122	1.5	10X	100	15 to 35	10	11		
P6149A	2	10X	50	20 to 51	10	13		

Maximum voltage DC + peak AC ≤500

ORDERING INFORMATION

P6006
10X, 35 MHz Rugged Probe **$220**
Includes: Retractable Hook Tip; Banana Tip; 5 in. Ground Lead, 12 in. Ground Lead; 0.055 in. diameter Straight Tip; Hook Tip; 0.080 in. diameter Spring Tip; Hook Tip; Two Miniature Alligator Clips; Probe Holder; Instruction Manual (070-0381-00).

P6053C
10X, 250 MHz Probe with Trace Identify **$225**
Includes: Bayonet Ground Tip; Retractable Hook Tip; 6 in. Ground Lead w/Square Pin Receptacle; Ground Collar; 2 in. Ground Lead; 4 pairs of Colored Cable Markers; SMT KlipChip™; Adjustment Tool; 6 in. Ground Lead w/Alligator Clip; Ground Cover; Hook Tip; Probe Holder; IC TEST TIP; Miniature Adapter; Instruction Sheet (070-7843-00).

P6062B
1X/10X, 100 MHz Switchable Probe with ground reference and read out functions ..... TD **$240**
Includes: Retractable Hook Tip; Probe Tip Ground Cover; 5 in. Ground Lead, 12 in. Ground Lead; Hook Tip; Two Replaceable Tips; Probe Holder; Alligator Clip; Instruction Sheet (062-2927-00).

P6063B
1X/10X, 200 MHz Switchable Probe with ground reference and read out functions ..... TD **$320**
Includes: Same as P6062B; Instruction Sheet (062-2928-01).

P6102A
10X, 60 MHz Modular Probe **$145**
Includes: Retractable Hook Tip; Probe Tip Ground Cover; 5 in. Ground Lead, 12 in. Ground Lead; Alligator Clip; 4 pairs of Colored Cable Markers; an adjustment tool; Instruction Sheet (070-5299-00).

P6105A
1X, 100 MHz Modular Probe ..... TD **$145**
Includes: Same as P6102A; Instruction Sheet (070-5516-00).

P6106A
10X, 250 MHz Modular Probe ..... TD **$190**
Includes: Same as P6102A except 3 in. ground lead instead of 12 in. ground lead; Instruction Sheet (070-5517-00).

P6108A
10X, 100 MHz Modular Probe with readout **$145**
Includes: Same as P6102A; Instruction sheet (070-5519-00).

P6122
10X, 100 MHz Modular Probe ..... TD **$95**
Includes: Same as P6102A; Instruction sheet (070-5512-00).

P6149A
10X, 50 MHz Modular Probe **$220**
Includes: Same as P6102A; Instruction sheet (070-5510-00).

OPTIONAL CABLE LENGTHS (P6053C,P6105A, P6106A, P6108A)
Opt. 01 – 1.5 or 1 meter cable ..... **+$30**
Opt. 03 – 3 meter cable ..... **+$35**

OPTIONAL CABLE LENGTHS (P6006)
Opt. 03 – 3 meter cable ..... **+$35**
Opt. 04 – 4 meter cable ..... **+$50**

TD
P6062B, P6063B, P6105A, P6106A and P6122 also available within 24 hours through TekDirect. Call 1-800-426-2200

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

P6130	P6136
P6131	P6137
P6133	P6138
P6134C	P6139A

Passive Voltage Probes

TDS Series & 2400 Series Oscilloscopes

Probes for TDS Series & 2400 Series Oscilloscopes.

P6130
- 10X, 250 MHz

P6131
- 10X, 300 MHz

P6133
- 10X, 150 MHz

P6134C
- 10X, 400 MHz

P6136
- 10X, 350 MHz

P6137
- 10X, 400 MHz

P6138
- 10X, 350 MHz

P6139A
- 10X, 500 MHz

TD

P6131, P6133, P6136, P6137, P6138, P6139A also available within 24 hours through TekDirect. Call 1-800-426-2200

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

Modular Subminiature Probes

- Small geometry tips - Easier circuit access
- Readout for 10X attenuation factor – Reduces confusion and errors in measurement readings.
- Flexible lightweight cable – Easier to use and reduces mechanical stress to device under test.
- HYBRID/SMT Circuitry – Provides improved performance and reliability.
- Modularity – Provides lower cost of ownership.
- Compact size accessories – Provides compatibility with existing adapters.
- UL safety certification.

The P613X family of oscilloscope probes set the standard for high performance passive voltage probes. Continued growth of the family paces Tektronix new series of high performance bench top oscilloscopes, the TDS 500 Series, and high performance portable oscilloscopes, the TDS 400 Series (with the introduction of the P6139A and P6138).

Both probes feature: modular construction, HYBRID/SMT circuitry, a smaller probe head/cable assembly than traditional passive probes, 10X attenuation readout encoding, and a full complement of attachment accessories. Smaller probe tips and light weight cable assemblies allow easy negotiation of dense circuitry or tight spaces.

The compact probe head/tip assembly is compatible with the full line of compact accessories. When the Subminiature/Compact-to-Miniature probe tip adapter (013-0202-02) is installed over the probe head/tip, the P6138 and P6139A probes are fully compatible with all miniature tip accessories.

The P6139A probe has been specifically designed for the TDS 500/600 Series of oscilloscopes to provide 500 MHz bandwidth at the probe tip while presenting an 8 pF/10 MΩ input impedance to the circuit under test. Similarly, the P6138's design meets the TDS 400 Series 350 MHz signal path requirements helping to ensure the highest accuracy ever in a general purpose oscilloscope.

P6130
- 10X Attenuation
- 250 MHz Bandwidth
- Subminiature Probe Tip

Scope Compatibility: 2400 Series

P6131
- 10X Attenuation
- 300 MHz Bandwidth
- Subminiature Probe Tip

Scope Compatibility: 2400 Series

P6133
- 10X Attenuation
- 150 MHz Bandwidth
- Subminiature Probe Tip

Scope Compatibility: 2400 Series

P6134C
- 10X Attenuation
- 400 MHz Bandwidth
- Subminiature Probe Tip

Scope Compatibility: 11000 Series

P6136
- 10X Attenuation
- 350 MHz Bandwidth
- Subminiature Probe Tip

Scope Compatibility: 2400 Series

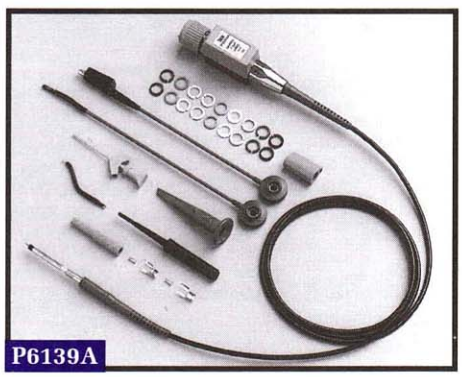
P6137
- 10X Attenuation
- 400 MHz Bandwidth
- Subminiature Probe Tip

Scope Compatibility: 2400 Series

P6137

P6138
- 10X Attenuation
- 350 MHz Bandwidth
- Subminiature Probe Tip

Scope Compatibility: TDS 400 Series


P6139A

P6139A
- 10X Attenuation
- 500 MHz Bandwidth
- Compact Tip

Scope Compatibility: TDS 500/600 Series

Passive Voltage Probes

TDS & 2400 Series Oscilloscopes

P6130	P6136
P6131	P6137
P6133	P6138
P6134C	P6139A

P613X SERIES PROBE SPECIFICATIONS CHART

Type	Cable Length meters (m)	Bandwidth Mega Hertz (MHz)	Attenuation	Comp. Range pico Farads (pF)	Input C pico Farads (pF)	System Input Resistance Mega Ohms (MΩ)	Read Out	Ground Ref.
P6130	2	250	10X	15 to 35	13.2	10	√	
Opt. 01	1.5	250			12.7			
Opt. 03	3	150			14.5			
P6131	1.3	300	10X	14 to 18	10.8	10	√	
Opt. 02	2	250			13.5			
Opt. 03	3	150			14.5			
P6133	2	150	10X	10 to 25	12.7	10	√	
Opt. 01	1.3	150			11.4			
Opt. 03	3	120			14.5			
Opt. 25	1.3	150			10.8			
P6134C	1.5	400	10X	12 to 18	11.3	10	√	√
P6136	1.3	350	10X	12 to 18	10.8	10		
Opt. 25	1.3	350			10.8			
P6137	1.5	400	10X	12 to 18	10.8	10	√	√
P6138	1.3	350	10X	12 to 18	10.0	10	√	√
P6139A	1.3	500	10X	8 to 12	8.0	10	√	√

Maximum voltage DC + peak AC ≤ 500; Opt. 25 substitutes Compact for Subminiature Tip.

ORDERING INFORMATION

P6130
10X, 250 MHz Modular Subminiature Probe **$185**
Includes: Retractable Hook Tip; Adjustment Tool; Circuit Board Connector; 8 in. Alligator Ground Lead; 6 in. Microhook Ground Lead; 2 in. Ground Lead; Probe Holder; 4 pairs of Colored Cable Markers; Instruction Sheet (070-5513-00).

Opt. 01 – 1.5 Meter Cable ..... **+$30**

Opt. 03 – 3 Meter Cable ..... **+$35**

P6131
10X, 300 MHz Modular Subminiature Probe ..... TD **$175**
Includes: Same as P6130 except instruction sheet (070-5514-00).

Opt. 02 – 2 Meter Cable ..... **+$30**

Opt. 03 – 3 Meter Cable ..... **+$35**

P6133
10X, 150 MHz Modular Subminiature Probe ..... TD **$155**
Includes: Same as P6130 except instruction sheet (070-5795-01).

Opt. 01 – 1.3 Meter Cable ..... **+$30**

Opt. 03 – 3 Meter Cable ..... **+$35**

Opt. 25 – 1.3 Meter Cable & Compact Tip ..... **+$35**
Includes: Same as P6137 except Instruction Sheet (070-5795-00).

P6134C
10X, 400 MHz Modular Compact Probe **$220**
Includes: Adjustment Tool; Retractable Hook Tip; Two Probe Tip to Circuit Board Adapters; 2 in. Ground Lead; 6 in. Ground Lead; Miniature Alligator Clip; SMT KlipChip™; 4 pairs of Colored Cable Markers; Instruction Sheet (070-7676-00).

P6136
10X, 350 MHz Modular Subminiature Probe ..... TD **$185**
Includes: Same as P6130 except instruction sheet (070-6025-01).

Opt. 25 – 1.3 meter cable & compact tip ..... **+$30**
Includes: Same as P6137 except Instruction Sheet (070-6025-00).

P6137
10X, 400 MHz Modular Compact Probe ..... TD **$195**
Includes: Adjustment Tool; Retractable Hook Tip; Two Circuit Board Connectors; 2 in. Ground Lead; 6 in. Ground Lead with 0.025 in. Square Pin Receptacle; 6 in. Ground Lead w/Alligator Clip; SMT KlipChip™; Low Inductance Lead Ground Collar; 4 pairs of Colored Cable Markers; Instruction Sheet (070-6432-00).

P6138
10X, 350 MHz Modular Compact Probe ..... TD **$175**
Includes: Adjustment Tool; Retractable Hook Tip; Two Circuit Board Connectors; 2 in. Ground Lead; 6 in. Ground Lead with 0.025 in. Square Pin Receptacle; 6 in. Ground Lead w/Alligator Clip; SMT KlipChip™; Low Inductance Lead Ground Collar; 2 in. Low Inductance Ground Lead; two Probe Tip to Circuit Board Adapters; 4 pairs of Colored Cable Markers; Accessory Pouch; Instruction Sheet (063-0835-00).

P6139A
10X, 500 MHz Modular Compact Probe ..... TD **$250**
Includes: Same as P6138 except instruction sheet (063-0870-00).

OPTIONAL ACCESSORIES
Conversion Kit – Subminiature Tip to Compact Tip.
P6130. Order 040-1252-02 ..... **$55**
P6131. Order 040-1251-02 ..... **$55**
P6133 Opt. 01. Order 040-1250-02 ..... **$55**
P6136. Order 040-1253-02 ..... **$60**

TD
P6131, P6133, P6136, P6137, P6138, P6139A also available within 24 hours through TekDirect. Call 1-800-426-2200

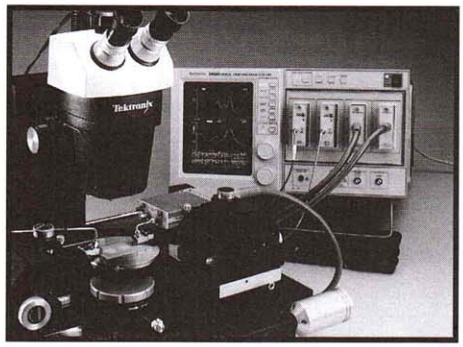
To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

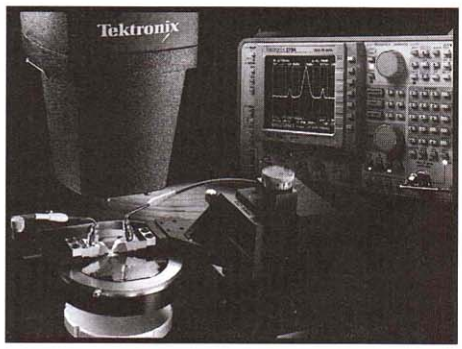
Microwave Probes

Achieves high speed coplanar connections for microwave circuits, MMICs, or microwave packages.

TMP9000 FAMILY

- The TMP9200 Series is a DC to 26.5 GHz Probe with a Signal-Ground Footprint
- The TMP9300 Series is a DC to 26.5 GHz Probe with a Ground-Signal Footprint
- The TMP9600 Series is a DC to 40 GHz Probe with a Ground-Signal-Ground Footprint
- The New TMP9600 Series, Opt. 01, is a DC to 50 GHz Probe with a Ground-Signal-Ground Footprint
- The New TMP9600 Series, Opt. 02, is a DC to 20 GHz Probe with a Ground-Signal-Ground Footprint
- The New TMP9800 Series is a DC to 60 GHz probe with a Ground-Signal-Ground Footprint
- Compatible with Industry-Standard Microwave Probe Stations, Including those Manufactured by Alessi





Microwave Probes

TMP9000 Microwave Probes are precision adapters that convert coaxial input into ground-signal configuration co-planar footprints which interface to hybrid microwave circuits, MMICs, or microwave packages. The superior performance of the Tektronix microwave probe is achieved by using photolithographic techniques to define the tapered co-planar transmission lines and contact bumps.

There are no needles for contacting the DUT pads as before with traditional probes and probe cards. Instead, each probe provides a 50 Ω transmission line between the coaxial connector and contacts at the probe tip. The replacement of contact needles by photolithographically-defined transmission line structures greatly improves the reflection, radiation, and crosstalk characteristics of probes at microwave frequencies.

Probes are available in discrete pitch increments from 100 to 300 microns. Probe input is through a female SMA connector, female K connector (2.92 mm), a female OS-50 connector (2.4 mm) or a female V connector (1.85 mm).

Calibration Algorithms

There are three dominate calibration algorithms, for on-wafer probing, in use today: Line-Reflect-Line (LRL), Line-Reflect-Match (LRM), and Short-Open-Load-Thru (SOLT). These calibration algorithms differ mainly in two areas:

- Required characterization of the calibration elements
- Bandwidth

All three methods are supported by Tektronix CAL93 and CAL96 substrates.

SOLT ALGORITHM

Required Characterization

Standard	Requirements
Short	Must be completely characterized.
Open	Must be completely characterized.
Load	Must be completely characterized.
Thru	Must be completely characterized.
Bandwidth	
Lower limit:	DC
Upper limit:	Determined by characterization and modeling accuracy.

LRM ALGORITHM

Required Characterization

Standard	Requirements
Line	Must be completely characterized.
Reflect	Reflection Coefficient (G) need not be known. Should be highly reflective (optimally |G|=1). Phase of G must be known within +/- 90 degrees. G must be the same on both ports.
Load	Must be completely characterized.
Bandwidth	
Lower limit:	DC
Upper limit:	Determined by characterization and modeling accuracy of the Line and especially the Load.

LRL ALGORITHM

Required Characterization

Standard	Requirements
Line 1	Characteristic Impedance the same as Line 2. Electrical length must be known*[1] if Line 1 is used to set reference planes at the probe tips.
Reflect	Reflection Coefficient (G) need not be known. Should be highly reflective (optimally |G|=1). Phase of G must be known within +/– 90 degrees. G must be the same on both ports.
Line 2	Characteristic Impedance must be known. Approximate electrical length must be known*[1] to determine bandwidth.
Line x x=3,4,..	Same as Line 2. These additional lines increase bandwidth.

[1] The NIST multi-line LRL software actually measures the propagation characteristics of the Lines. The program only requires an estimate of the effective dielectric constant.

Bandwidth

Lower limit:	Determined by the longest Line that is used. On Tektronix' CAL96 the lower limit is 1.5 GHz.
Upper limit:	Determined by the shortest Line (besides Line 1) and the software used to implement the algorithm.

Microwave Probes

TMP9800 60 GHz Probe

New TMP9815

TMP9800 Series

The TMP9800 millimeter wave wafer probe sets the standard for high quality millimeter wave measurements. When used in conjunction with the CAL96 calibration substrate, measurements can be referenced to the smallest device bond pads for accurate process characterization or equivalent circuit extraction.

Lithographicallly defined pitches insure probe contacts just as accurate as your device's bond pads, critical for today's small geometry FETs.

The TMP9800 offers superior planarity by design resulting in reliable contact with as little 2 mils of overtravel.

TMP9800 is supplied with a 1.85 mm coaxial connector and ground-signal-ground contact configuration in pitches of 50, 100, 150, and 200 microns.

Superior electrical performance is crucial at millimeter wave frequencies. The ability to distinguish between calibration standards at the probe tip is necessary for noise-free calibrations. The low insertion loss and high return loss of the TMP9800 ensures maximum dynamic range and minimum degradation of your test set specifications.

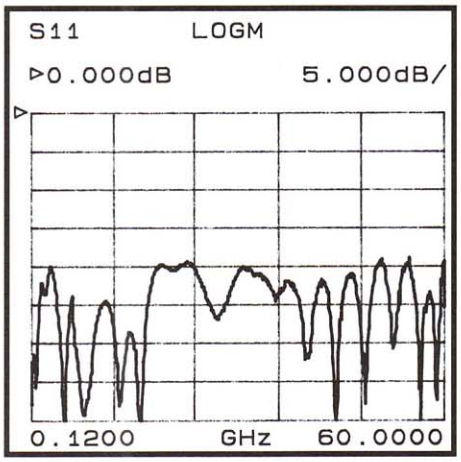
Characteristics

Insertion Loss – 2.5 dB typical, 3 dB max to 60 GHz.

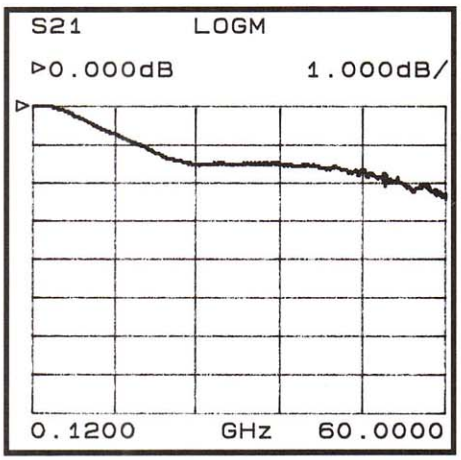
Return Loss – 20 dB to 4 GHz typical; 10 dB min to 60 GHz.

Connection Repeatability[1] – <–50 dB typical.

Pitch Accuracy – Better than 1%.



Typical TMP9800 return loss.



Typical TMP9800 insertion loss.

Contact Width – 1.0 mils for TMP9805; 2.0 mils for all others typical.

Planarity – 1:100.

Crosstalk[2] – 30 dB max @ 60 GHz.

Overtravel – 2-3 mils recommended; 15 mils max.

Lifetime – >500,000 cycles typical.

Temperature Range – –20° to +125°C wafer or DUT temp.

**1 Connection repeatability is expressed as the magnitude of the vector difference between subsequent connections and is a strong function of the operator and probe positioning mechanics.*

**2 Crosstalk measured with two probes 4 mils apart contacting a bare alumina substrate.*

TMP9800 SERIES

- DC to 60 GHz with the 1.85 mm Coaxial Connector
- New 50 Micron Pitch
- 2.5 dB Typical Insertion Loss
- Exclusive Tip Finishing Process
- Epoxy Based Mode Suppressor
- Superior Metal Adhesion

New – Millimeter Wave Performance to 60 GHz sets the standard for device characterization.

ORDERING INFORMATION

TMP9800 SERIES MICROWAVE PROBES

TMP9805 – 50 micron pitch.
Includes: Storage Case and User's Guide.

TMP9810 – 100 micron pitch.
Includes: Storage Case and User's Guide.

TMP9815 – 150 micron pitch.
Includes: Storage Case and User's Guide.

TMP9820 – 200 micron pitch.
Includes: Storage Case and User's Guide.

For further information, contact:
ATN Microwave, Inc., 11 Executive Park Drive, Billerica, MA 01812
Phone: (508) 667-4200, FAX: (508) 667-8548

Sony/Tektronix Corporation, P.O. Box 5209,
Tokyo Int'l, Tokyo 100-31, Japan
Phone: 81 (3) 3448-4611, FAX: 81 (3) 3444-0318

TMP9600 SERIES TMP9300 SERIES TMP9200 SERIES Microwave Probes

A wide variety of connector schemes and foot prints accomodates your metrology needs.

TMP9600 SERIES

- Ground-Signal-Ground Contacts
- Available Pitch Increments: 100, 125, 150, 175, 200 and 250 Microns
- Available in SMA, K, or 2.4 mm Connectors
- DC to 50 GHz
- Low Insertion Loss

TMP9200/TMP9300 SERIES

- Signal-Ground or Ground-Signal Contacts
- K Connector
- DC to 26.5 GHz
- Available Pitch Increments: 100, 150, 200, 250, and 300 Microns

APPLICATIONS:

- S-Parameter Measurements
- Noise Measurements
- TDR Measurements
- Characterization of Packages

TMP9600 Series

TMP9600 Series Characteristics

Frequency Range – DC to 50 GHz

Insertion Loss –
Maximum 1.2 dB to 20 GHz (Opt. 02)
1.5 dB to 26 GHz (Typical).
Maximum 2.5 dB to 40 GHz.
Maximum 2.8 dB to 50 GHz (Opt. 01).

Return Loss –
Greater than 10 dB to 20 GHz (Opt. 02).
Greater than 10 dB to 40 GHz.
Greater than 10 dB to 50 GHz (Opt. 01).

Connection Repeatability*1 – <–50 dB typical.

Crosstalk*2 – Less than 30 dB thru 50 GHz.

Planarity – 1:100.

Temperature Range – –20°C to +125°C.

Nominal Impedance – 50 Ω.

Maximum Overtravel – 15 mils (0.38 mm).

Recommended Overtravel – 2-3 mils.

Lifetime – >500,000 cycles typical.

TMP9200 & TMP9300 Series Characteristics

Frequency Range – DC to 26.5 GHz.

Insertion Loss – Less than 1.0 dB to 18 GHz (typical). Maximum 2.0 dB to 26.5 GHz.

Return Loss – Greater than 20 dB to 4 GHz Greater than 10 dB to 26.5 GHz.

Crosstalk*2 – Less than 30 dB to 26.5 GHz.

Planarity – 1:100.

Temperature Range – –20°C to +125°C.

Nominal Impedance – 50 Ω.

Maximum Overtravel – 15 mils (0.38 mm).

Recommended Overtravel – 2-3 mils.

Lifetime – >500,000 cycles typical.

**1 Connection repeatability is expressed as the magnitude of the vector difference between subsequent connections and is a strong function of the operator and probe positioning mechanics.*

**2 Crosstalk measured with two probes 4 mils apart contacting a bare alumina substrate.*

ORDERING INFORMATION

TMP9600 SERIES MICROWAVE PROBES, GSG CONTACTS

TMP9610 – 100 micron pitch.
TMP9612 – 125 micron pitch.
TMP9615 – 150 micron pitch.
TMP9617 – 175 micron pitch.
TMP9620 – 200 micron pitch.
TMP9625 – 250 micron pitch.
Opt.01 – Female OS-50 connector, tested to 50 GHz.
Opt.02 – Female SMA connector, tested to 20 GHz.

TMP9200 SERIES MICROWAVE PROBES, SG CONTACTS

TMP9210 – 100 micron pitch.
TMP9215 – 150 micron pitch.
TMP9220 – 200 micron pitch.
TMP9225 – 250 micron pitch.
TMP9230 – 300 micron pitch.

TMP9300 SERIES MICROWAVE PROBES, GS CONTACTS

TMP9310 – 100 micron pitch.
TMP9315 – 150 micron pitch.
TMP9320 – 200 micron pitch.
TMP9325 – 250 micron pitch.
TMP9330 – 300 micron pitch.

For further information, contact:
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Phone: (508) 667-4200, FAX: (508) 667-8548

Sony/Tektronix Corporation, P.O. Box 5209,
Tokyo Int'l, Tokyo 100-31, Japan
Phone: 81 (3) 3448-4611, FAX: 81 (3) 3444-0318

Microwave Probes

Calibration Substrates & Accessories

CAL93 LRL Substrate

The CAL93 LRL substrate is intended for use with TMP9200/TMP9300 Series with 100 µm to 300 µm pitch.

Substrate

Single crystal Sapphire, "0" degree cut

Dielectric constant	9.39 perpendicular to c axis
Surface finish	<250 angstrom
Thickness	20 ±1 mils
Camber	<2 µm/in.

Metalization

Hard gold plate over evaporated thin-film gold

Hardness	150 Knoop typical

Match Standards.

Passivated Nichrome, laser trimmed, Guaranteed sites:

Pitches ≤200 µm	40 loads plus 8 loads at 90 degree orientation.
Pitches >200 µm	20 loads plus 4 loads at 90 degree orientation.
DC accuracy	50 Ω ±1%
TCR	35 ppm/degree C
Stability	0.1%/1000 hrs @ 150 degree C
Return loss	Better than –30 dB to 26.5 GHz with recommended overlap.

Line Standards

Asymmetrical coplanar strips

Frequency Range	5-26.5 GHz
Frequency Response	±0.25 Ω typical
Impedance	50 Ω ±2 Ω typical

Reflect Standards

Offset shorts and opens. Offset provided as a function of pitch.

Pitch ≤200 µm	125 µm nominal offset
Pitch >200 µm	150 µm nominal offset
DPS Open C_o =	+8FF typical
CPS Short offset =	0.3 pS typical

CAL96 LRL Substrate

The CAL96 LRL substrate is intended for use with TMP9600 Series with 100 µm to 300µm pitch.

Calibration Elements
Open-Short-Load-Thru

Pitch (microns)	Short[1] offset(ps)	Open1[2] Co(fF)	Open 2[3] Co(fF)	Thru[4] delay(ps)
100	0.1	–1	–10	0.8
125	0.1	–2	–11	0.8
150	0.2	–2	–11	0.8
175	0.2	–2	–12	0.8
200	0.2	–2	–12	0.8
250	0.2	–2	–12	0.8

[1]*The short offsets above apply when the probe is positioned in the center of the shorting bar.*

[2]*Open1 is defined as the probe on the bare sapphire with no metal under the last 50 mils of probe tip and 1 to 2 mils of overtravel applied. Open1 is recommended.*

[3]*Open2 is defined as the probe in air, 30 mils above the substrate.*

[4]*The 0.8 ps Thru applies when the Thru is probed with 1 mil overlaps.*

Line-Reflect-Line

Line (label)	Electrical Length (ps)	(Ω)
LT	0.8	50
L1	11.5	50
L2	20.3	50
Impedance		Range of Z_o 47-50 Ω Frequency response of Z_o ±0.25 Ω from 5 to 26.5 GHz

50 Ω loads – Minimum of 10 each Load type

Trimmed to 50 Ω ±1%

Typical Return Loss:

>34 dB up to 26 GHz;

>30 dB up to 40 GHz;

>25 dB up to 60 GHz

Microwave Wafer Spacer

- Improves calibration measurement accuracy.
- Accommodates wafers to 4-inch diameter.
- Provides vacuum masking for securing wafer shards or calibration substrates.
- Maintains planarity with surfaces parallel to better than 0.5 mil/inch.

Physical Characteristics

Diameter	4.0 in. ±.02 in.
Thickness	80 mils ±2 mils.
Parallelism	<0.5 mil/in. between surfaces.
Flatness	≤5 waves/in.
Material	Quartz, Er = 3.5 typical.

CAL93

- Industry's first LRL calibration support for SG/GS probes
- Full NIST compatibility for multiple line LRL calibrations permits characterization of secondary LRM standards
- Complete support for all popular calibration methods including LRM and SOLT
- Superior metrology grade '0' degree sapphire substrate for maximum Zo precision and lowest loss
- High stability laser trimmed 50 Ω loads provide the lowest inductance available
- Durable hard plated gold metalization for longer life and lowest cost per calibration
- LRL elements provide 1 to 26.5 GHz calibrations, DC to 26.5 GHz with low-band load

CAL96

- LRL Calibration for GSG Probes
- 40 laser trimmed loads in increments of 100, 150, 200, and 250 microns (also calibrates 125 and 175 micron probes)
- Line-reflect-line elements provide 2.5 to 20 GHz and 5 to 40 GHz calibration
- LRM elements provide calibration to 60 GHz

High accuracy calibration methods including NIST multi-line LRL are offered by CAL93 and CAL96.

ORDERING INFORMATION

CAL96 LRL
Calibration Substrate
Includes: Resistor Trim Map, Wafer Tray.

CAL93 LRL
Calibration Substrate

Microwave Wafer Spacer – Order 010-0558-01.

For further information, contact:
ATN Microwave, Inc., 11 Executive Park Drive, Billerica, MA 01812
Phone: (508) 667-4200, FAX: (508) 667-8548

Sony/Tektronix Corporation, P.O. Box 5209,
Tokyo Int'l, Tokyo 100-31, Japan
Phone: 81 (3) 3448-4611, FAX: 81 (3) 3444-0318

Replacement Parts

PASSIVE AND ACTIVE PROBE GENERAL REPLACEMENT PARTS

Probe	Length(m)	Connector/ Comp Box	Price	Probe Cable	Price	Probe Head	Price	Probe Tip Hybrid Tip	Price
P6101A	1	103-0189-00	**$22.00**	174-0975-00	**$20.00**	206-0223-02	**$22.00**	206-0191-03*3	**$23.00**
(P6101A replaced	2	103-0189-00	**$22.00**	174-0976-00	**$23.00**	206-0223-02	**$22.00**	206-0191-03*3	**$23.00**
by P6101B)	3	103-0189-00	**$22.00**	174-0977-00	**$25.00**	206-0223-02	**$22.00**	206-0191-03*3	**$23.00**
P6101B	2	N/A		N/A		N/A		131-4997-01*4	**$5.00**
P6102A	2	206-0352-00	**$50.00**	174-0976-00	**$23.00**	206-0302-00	**$28.00**	206-0338-01*4	**$44.00**
P6103*7	1	N/A		174-0394-00	**$20.00**	206-0365-03	**$28.00**	131-3723-03*1	**$12.75**
(P6103 replaced	2	N/A		174-0395-00	**$22.00**	206-0361-03	**$34.00**	131-3723-03*1	**$12.75**
by P6103B)	3	N/A		174-0396-00	**$24.00**	206-0367-02	**$28.00**	131-3723-03*1	**$12.75**
P6103B	2	N/A		N/A		N/A		131-4997-01*4	**$5.00**
P6105A	1	206-0331-00	**$72.00**	174-0975-00	**$20.00**	206-0328-00	**$26.00**	206-0336-01*4	**$44.00**
	2	206-0334-00	**$85.00**	174-0976-00	**$23.00**	206-0301-00	**$26.00**	206-0337-01*4	**$39.00**
	3	206-0320-02	**$66.00**	174-0977-00	**$25.00**	206-0302-00	**$28.00**	206-0338-01*4	**$44.00**
P6106A	1	206-0313-01	**$90.00**	174-0975-00	**$20.00**	206-0328-00	**$26.00**	206-0336-01*4	**$44.00**
	2	206-0319-01	**$95.00**	174-0976-00	**$23.00**	206-0301-00	**$26.00**	206-0337-01*4	**$39.00**
	3	206-0320-01	**$90.00**	174-0977-00	**$25.00**	206-0302-00	**$28.00**	206-0338-01*4	**$44.00**
P6107A	2	206-0247-02	**$77.00**	174-0976-00	**$23.00**	206-0217-02	**$28.00**	206-0339-03*4	**$27.00**
P6108A	1	206-0332-01	**$50.00**	174-0975-00	**$20.00**	206-0303-00	**$22.00**	206-0336-01*4	**$44.00**
	2	206-0318-02	**$55.00**	174-0976-00	**$23.00**	206-0304-00	**$27.00**	206-0337-01*4	**$39.00**
	3	206-0333-00	**$50.00**	174-0977-00	**$25.00**	206-0305-00	**$22.00**	206-0338-01*4	**$44.00**
P6109*7	1.5	N/A		174-0714-00	**$24.00**	206-0372-02	**$39.00**	131-3723-03*1	**$12.75**
(P6109 replaced	2	N/A		174-0715-00	**$23.00**	206-0360-03	**$43.00**	131-3723-03*1	**$12.75**
by P6109B)	3	N/A		174-0393-00	**$25.00**	206-0366-02	**$39.00**	131-3723-03*1	**$12.75**
P6109B	2	N/A		N/A		N/A		131-4997-01*4	**$5.00**
P6111B	2	N/A		N/A		N/A		131-4997-01*4	**$5.00**
P6119 (P6119 by	2	N/A		174-0395-00	**$22.00**	206-0405-00	**$49.00**	131-3723-03*1	**$12.75**
replaced P6119B)	3	N/A		174-0396-00	**$24.00**	206-0412-00	**$40.00**	131-3723-03*1	**$12.75**
P6119B	2	N/A		N/A		N/A		131-4997-01*4	**$5.00**
P6121	1.5	206-0311-00	**$72.00**	174-0967-00	**$20.00**	206-0323-00	**$29.00**	206-0341-01*4	**$50.00**
P6122	1.5	206-0312-00	**$61.00**	174-0967-00	**$20.00**	206-0324-00	**$25.00**	206-0342-01*4	**$44.00**
	2	206-0318-00	**$55.00**	174-0968-00	**$22.00**	206-0325-00	**$23.00**	206-0343-01*4	**$34.00**
	3	206-0318-01	**$55.00**	174-0969-00	**$23.00**	206-0326-00	**$24.00**	206-0344-01*4	**$34.00**
P6129	2	N/A		174-0395-00	**$22.00**	206-0405-00	**$49.00**	131-3723-03*1	**$12.75**
(P6129 replaced by P6129B)									
P6129B	2	N/A		N/A		N/A		131-4997-01*4	**$5.00**
P6130	1.5	206-0313-00	**$90.00**	174-0970-00	**$25.00**	206-0270-10	**$19.00**	206-0270-10*5	**$19.00**
	2	206-0319-00	**$90.00**	174-0971-00	**$30.00**	206-0270-12	**$18.00**	206-0270-12*5	**$18.00**
	3	206-0320-00	**$90.00**	174-0972-00	**$35.00**	206-0270-11	**$18.00**	206-0270-11*5	**$18.00**
P6131	1.3	206-0314-00	**$100.00**	174-0973-00	**$25.00**	206-0265-10	**$18.00**	206-0265-10*5	**$18.00**
	2	206-0321-00	**$100.00**	174-0971-00	**$30.00**	206-0265-12	**$18.00**	206-0265-12*5	**$18.00**
	3	206-0322-00	**$100.00**	174-0972-00	**$35.00**	206-0265-11	**$18.00**	206-0265-11*5	**$18.00**
P6133	2	206-0350-00	**$75.00**	174-0971-00	**$30.00**	206-0265-12	**$18.00**	206-0265-12*5	**$18.00**
Opt.01	1.3	206-0349-00	**$75.00**	174-0973-00	**$25.00**	206-0265-13	**$18.00**	206-0265-13*5	**$18.00**
Opt.03	3	206-0351-00	**$75.00**	174-0972-00	**$35.00**	206-0265-11	**$18.00**	206-0265-11*5	**$18.00**
Opt.25	1.3	206-0349-00	**$75.00**	174-0973-00	**$25.00**	206-0393-00	**$18.50**	206-0393-00*5	**$18.50**

**1 Package of 5 Tips*
**2 Min. (Miniature), Com. (Compact), Sub. (Subminiature)*
**3 Probe tips in package of ten*
**4 Probe hybrid tip assemblies in packages of five*
**5 Probe hybrid tip assembly in quantities of one*
**6 Contact your local Tektronix Account Manager for information*
**7 Replacement probe sleeve cover for compensation adjustment is P/N 200-3342-00*
**8 Consists of a Matched pair*
**9 20 pF inputs*
**10 47 pF inputs*
**11 15 pF inputs*
**12 Package of 2*

Replacement Parts

PASSIVE AND ACTIVE PROBE GENERAL REPLACEMENT PARTS

Probe	Length(m)	Connector/ Comp Box	Price	Probe Cable	Price	Probe Head	Price	Probe Tip/ Hybrid Tip	Price
P6134 (P6134 replaced by P6134C)	1.5	*6	*6	*6	*6	206-0265-13	$18.00	206-0265-13*5	$18.00
P6134C	1.5	206-0420-00	$90.00	174-1081-04	$55.00	206-0418-00	$18.00	206-0418-00*5	$18.00
P6135 (P6135 replaced by P6135A)	1.5	206-0368-00	$105	174-0707-01*8	$90.00	206-0369-00	$19.00	206-0369-00*8	$19.00
P6135A (13-17pF)	1.5	N/A		N/A		(tip - red / tail - natural)		206-0416-00*8*9	$25.00
(18-22pF)		N/A		N/A		(tip - black / tail - yellow)		206-0419-00*8*10	$25.00
(45-49pF)		N/A		N/A		(tip - blue / tail - natural)		206-0415-00*8*11	$25.00
P6136	1.3	206-0359-00	$100	174-0978-00	$28.00	206-0265-10	$18.00	206-0265-10*5	$18.00
Opt. 25	1.3	206-0359-00	$100	174-0978-00	$28.00	206-0392-00	$18.25	206-0392-00*5	$18.25
P6137	1.5	206-0389-01	$110	174-1081-04	$55.00	206-0378-00	$18.00	206-0378-00*5	$18.00
P6138	1.3	206-0439-00	$120	174-0978-00	$28.00	206-0392-00*5	$18.25	206-0392-00*5	$18.25
P6139A	1.3	206-0440-00	$70.00	174-0978-00	$28.00	206-0441-00*5	$17.50	206-0441-00*5	$17.50
P6148A	2	206-0255-02	$90.00	174-0976-00	$23.00	206-0217-02	$28.00	206-0339-03*4	$27.00
P6149A	2	206-0255-02	$90.00	174-0976-00	$23.00	206-0217-02	$28.00	206-0339-03*4	$27.00
P6150 (10X)	1	N/A		174-1341-00	$265	206-0399-03*5	$460	206-0399-03*5	$460
(1X)		N/A				206-0398-00*5	$215	206-0398-00*5	$215
P6156 (10X)	1.5	N/A		174-1127-00	*12	N/A		206-0380-00*5	$65.00
Opt.25 adds 100X tip		N/A		N/A		N/A		206-0382-00*5	$80.00
Opt.26 adds 20X tip		N/A		N/A		N/A		206-0381-00*5	$65.00
Opt.27 adds 1X tip		N/A		N/A		N/A		206-0379-00*5	$65.00
P6202A	2	N/A		N/A		N/A		206-0230-03*3	$33.00
P6203	1.5	N/A		N/A		206-0391-00	$165	131-4280-00	$2.00
P6204	1.5	N/A		N/A		206-0390-00	$625	131-4280-00	$2.00
P6205	1.5	N/A		N/A		N/A		131-4280-00	$2.00
P6206	1.7	N/A		N/A		N/A		131-4280-00	$2.00
P6230	1.6	N/A		N/A		206-0279-10	$18.25	206-0279-10*5	$18.25
P6231	1.5	N/A		N/A		206-0279-10	$18.25	206-0279-10*5	$18.25
P6420	1	N/A		174-0975-00	$20.00	206-0236-01	$55.00	206-0230-03*3	$33.00
	2	N/A		174-0976-00	$23.00	206-0236-01	$55.00	206-0230-03*3	$33.00
	3	N/A		174-0977-00	$25.00	206-0236-01	$55.00	206-0230-03*3	$33.00
P6501/P6507 (Palladium 0.20 in.)		N/A		N/A		N/A		206-0370-02*1	$38.00
(Tungsten 0.20 in.)		N/A		N/A		N/A		206-0371-02*1	$30.00
(Palladium 0.46 in.)		N/A		N/A		N/A		206-0370-03*1	$38.00
(Tungsten 0.46 in.)		N/A		N/A		N/A		206-0371-03*1	$30.00

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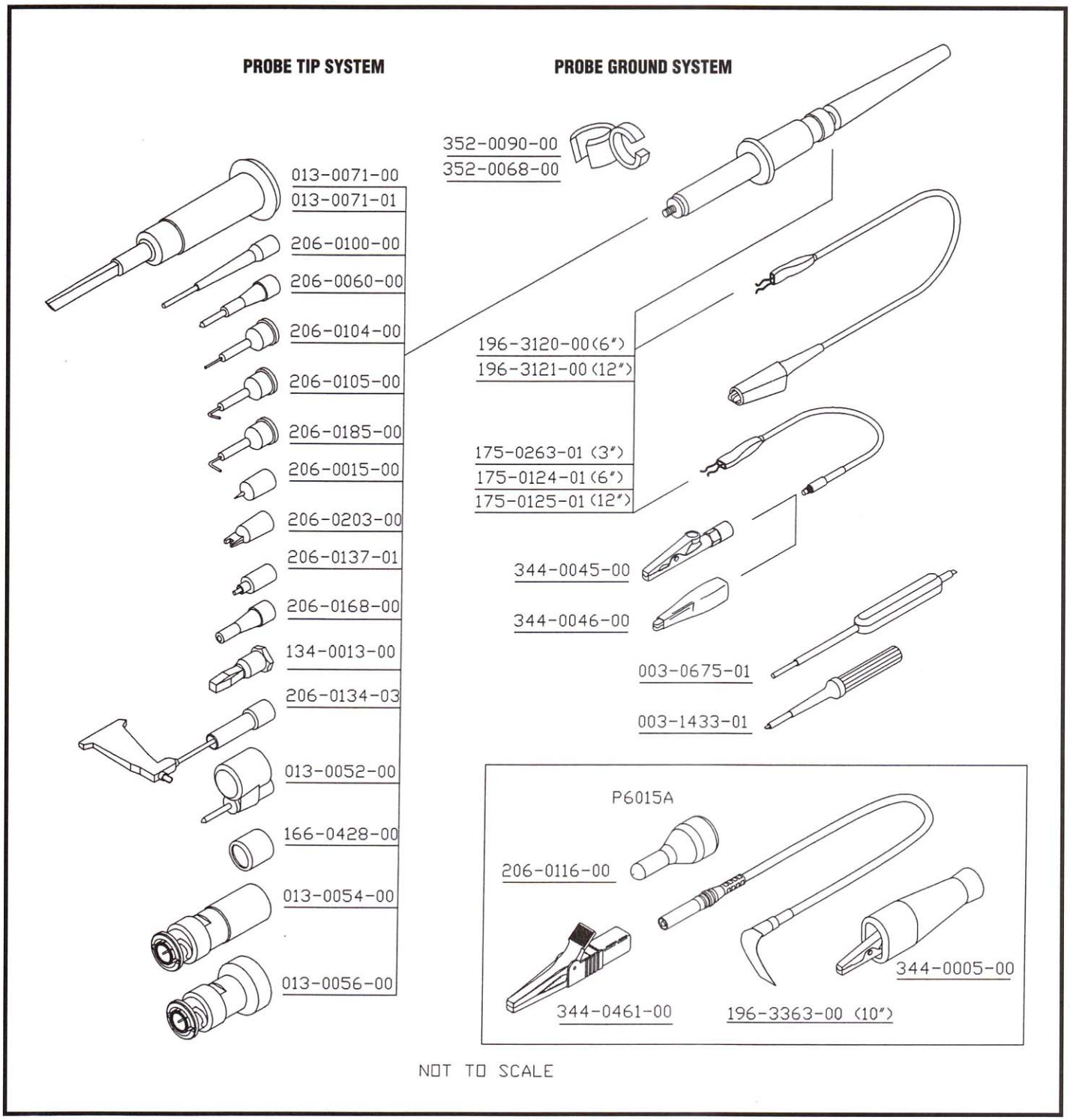
To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

Probe Accessories

Probe Accessories Selection Guide

Monolithic Series for P6015A, P6006, P6007, P6008, P6009, P6028, P6060, and P6201 Active FET Probe

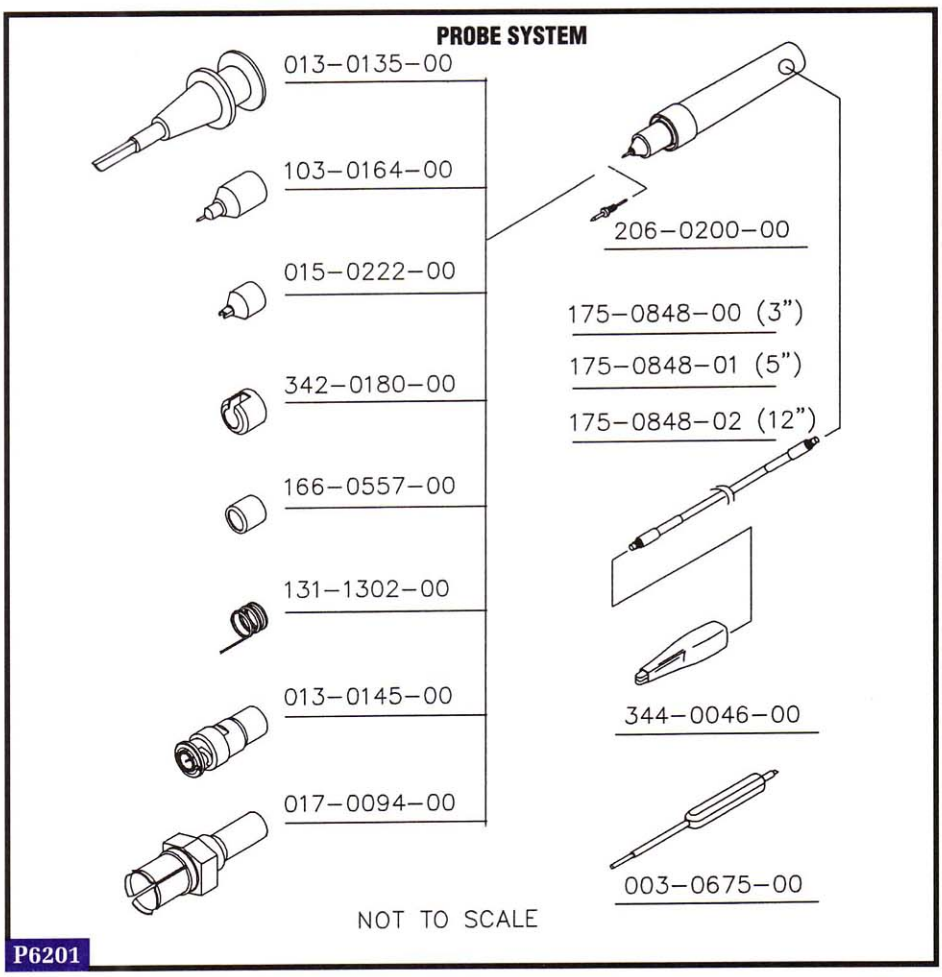


Probe Accessories

ORDERING INFORMATION – SELECTION GUIDE

MONOLITHIC PROBE ACCESSORIES
(For probes with # 6-32 Screw Tips)

Part Number	Description	Price
003-0675-01	Adjust Tool	**$2.65**
003-1433-00	Adjust Tool for P600X Family	**$1.05**
003-1433-01	Pkg of 5	**$5.25**
013-0052-00	Bayonet Ground Assembly	**$15.50**
013-0054-00	Probe Screw Tip to BNC Adapter.	**$24.00**
013-0056-00	Probe Screw Tip to BNC Adapter for P6028	**$24.00**
013-0071-00	Retractable Hook Tip	**$7.25**
013-0071-01	Retractable Hook for P6008 Environmental Probe.	**$5.50**
134-0013-00	Banana Tip (#6-32)	**$1.80**
166-0428-00	Insulating Ground Cover for P6009	**$1.10**
175-0124-01	5 in. Ground Lead	**$3.25**
175-0125-01	12 in. Ground Lead	**$3.50**
175-0263-01	3 in. Ground Lead	**$3.00**
175-0192-00	6 in. Ground Lead (P6015 only)	**$10.50**
196-3120-00	6 in. Clip on Ground Lead	**$3.30**
196-3121-00	12 in. Clip on Ground Lead	**$4.10**
196-3363-00	10 in. Clip on Ground Lead for P6015A	**$18.00**
206-0015-00	Straight Tip (0.055 in. dia)	**$2.50**
206-0060-00	Spring Tip (0.08 in. dia)	**$6.50**
206-0100-00	Calibration Tip (0.063 in. dia)	**$13.75**
206-0104-00	Long Straight Tip (0.032 in. dia)	**$1.80**
206-0105-00	Hook Tip	**$2.00**
206-0116-00	Banana Tip (P6015 only) #10-32	**$3.20**
206-0134-03	Pin Tip (accepts 0.025 in. IBM SLT pin)	**$8.75**
206-0137-01	Ground Lead Adapter (0.025 in. square pin closing)	**$5.25**
206-0168-00	Spring Tip (accepts 0.068 in. dia pin)	**$4.50**
206-0185-00	Right Angle Hook Tip.	**$2.00**
206-0203-00	IC Test Tip	**$2.15**
344-0005-00	Alligator Clip, # 10-32 Screw Thread (P6015 only)	**$5.75**
344-0045-00	Alligator Clip	**$1.45**
344-0046-00	Miniature Alligator Clip with Boot TD	**$2.95**
344-0461-00	Crocodile Clip, 4 mm socket	**$10.00**
352-0090-00	P600X Probe Holder	**$.50**
352-0068-00	P600X Probes to Scope Chassis Probe Holder	**$2.55**



P6201 PROBE

Product Number	Description	Price
003-0675-00	Adjustment Tool	**$3.00**
013-0135-00	Retractable Hook Tip.	**$8.75**
013-0145-00	Probe Tip to BNC Adapter	**$33.00**
015-0222-00	IC Test Ground Cover	**$1.00**
017-0094-00	Probe Tip to GR 50 Ω Termination Adapter	**$135.00**
103-0164-00	Probe Tip to Miniature Probe Tip Adapter (See page 476 for compatible accessories)	**$16.75**
131-1302-00	Ground Contact	**$1.50**
166-0557-00	Insulating Ground Cover	**$1.75**
175-0848-00	3 in. Ground Lead	**$6.25**
175-0848-01	5 in. Ground Lead	**$3.55**
175-0848-02	12 in. Ground Lead	**$3.75**
206-0200-00	Replaceable Probe Tip	**$2.00**
342-0180-00	Ground Contact Insulator	**$2.00**
344-0046-00	#6-32 Thread Alligator Ground Clip TD	**$2.95**

IC CLIPS (NOT SHOWN)

003-0709-00	16-Pin DIP, clothes pin style.	**$18.00**
003-0823-00	24-Pin DIP, clothes pin style.	**$37.00**
003-0801-00	40-Pin DIP, clothes pin style.	**$53.00**

CABLE MARKER SETS (NOT SHOWN)

016-0127-00	For 3/16 in. dia. Cable	**$24.00**
016-0633-00	For all Modular Cables (P610X/A, P612X/ P613X/P6230 families)	**$5.00**

[1] Contact your local Tektronix representative for price information.

TD
Product also available within 24 hours through TekDirect. Call 1-800-426-2200

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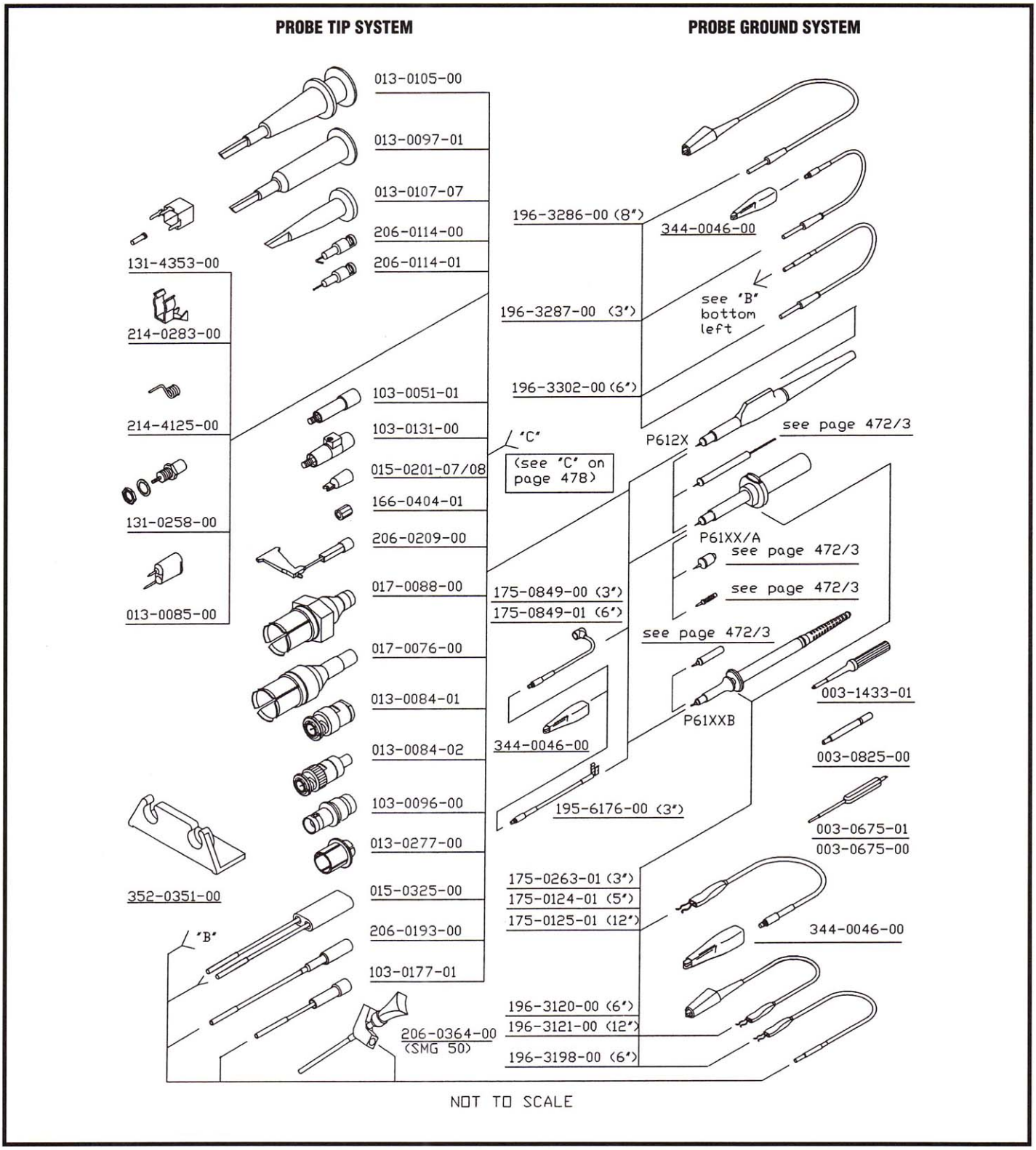
Probe Accessories

Probe Accessories Selection Guide

Miniature Tip Series for P6048, P6053B, P6055, P6056, P6057, P6062B, P61XX/A Families, P612X Family, P61XXB Family, P6202A w/Adapter, P6203, P6204, P6205, and P6206.

P6150, P6207, P6217 and SD14 see next page.

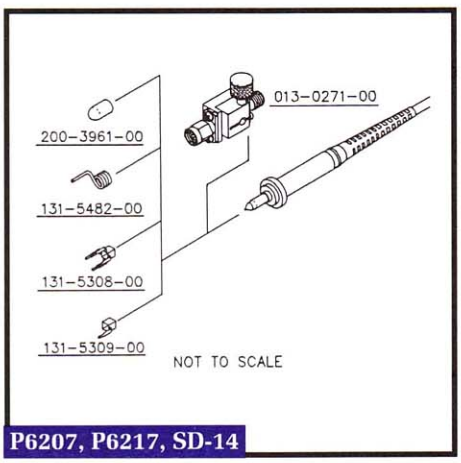


Probe Accessories

ORDERING INFORMATION – SELECTION GUIDE

MINIATURE PROBE ACCESSORIES

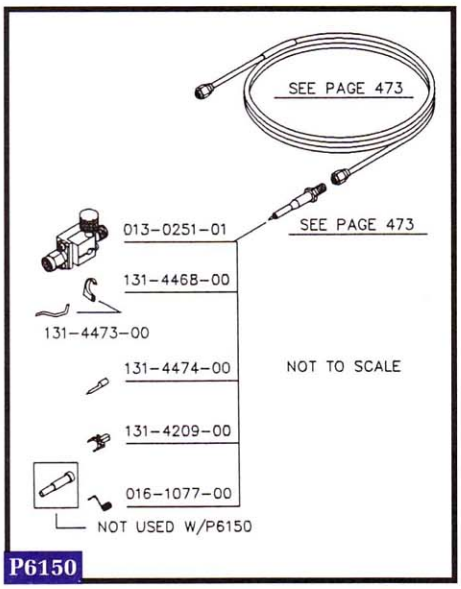
Part Number	Description	Price
003-0675-00	Adjustment Tool P6055	$3.00
003-0675-01	Adjustment Tool P6202A	$2.65
003-0825-00	Tip Extractor for Miniature Probes (except for P610X "A" version and P612X family probes)	$7.00
003-1433-00	Adjustment Tool for P601XA, P612X, and P613X family	$1.05
003-1433-01	Package of 5 each of 003-1433-00, above	$5.25
013-0084-01	Miniature Probe Tip to BNC Adapter TD	$14.25
013-0084-02	Miniature Probe Tip to BNC Adapter for all except P6202A, P6420, and P6201 Adapter TD	$14.50
013-0085-00	Bayonet Ground Assembly	$13.25
013-0097-01	Retractable Hook Tip for P6202A and P6420	$15.75
013-0105-00	Retractable Hook Tip (except P612X)	$17.75
013-0107-07	Retractable Hook Tip (for all except P6202A and P6420)	$5.25
013-0277-00	Slip on Miniature Probe Tip to BNC Adapter	*1
015-0201-07	IC Test Ground Cover, gray. Package of 10	$8.00
015-0201-08	Package of 100	$21.00
015-0325-00	Dual Lead Adapter.	$19.50
017-0076-00	Miniature Probe Tip to GR Adapter.	$95.00
017-0088-00	Miniature Probe Tip GR 50 Ω Termination Adapter.	$90.00
103-0051-01	Screw Tip (#6-32)	$6.00
103-0096-00	Miniature Probe Tip to BNC Female Adapter	$16.50
103-0131-00	Screw Tip with Ground Connection (#6-32)	$21.00
103-0177-01	Flexible Tip	$9.50
131-0258-00	Chassis Mount Test Jack	$3.50
131-3723-03	Replaceable Tip for P6103, P6109, and P6119, Pkg. 5	$12.75
131-4280-00	Replaceable Tip for P6203 and P6204	$2.00
131-4353-00	Circuit Board Test Point, package of 25	$49.00
166-0404-01	Insulating Ground Cover	$1.65
175-0124-01	5 in. Clip on Ground Lead	$3.25
175-0125-01	12 in. Clip on Ground Lead	$3.50
175-0263-01	3 in. Clip on Ground Lead	$3.00
175-0849-00	3 in. Probe Tip Cap Lead for all miniature size probe tips	$8.75
175-0849-01	6 in. Probe Tip Cap Lead for all miniature size probe tips	$9.00
195-6176-00	3 in. Probe Tip Clip-On Lead for all miniature size probe tips	$7.75
196-3120-00	6 in. Clip-On Ground Lead	$3.30
196-3121-00	12 in. Clip-On Ground Lead	$4.10
196-3198-00	6 in. Clip on Ground Lead (with 0.025 in. pin receptacle)	$5.25
196-3286-00	8 in. Ground Lead.	$9.00
196-3287-00	#6-32 Thread Ground Lead	$10.25
196-3302-00	6 in. Slip On Ground Lead (with 0.025 in. pin receptacle)	$13.50
206-0114-00	Hook Tip	$4.75
206-0114-01	Straight Tip.	$5.25
206-0193-00	Flex Tip for 0.025 in. square pin	$19.00
206-0209-00	Pin Tip (accepts 0.025 in. IBM SLT pin).	$7.00
206-0364-00	SMT KlipChip™ (used with 0.025 pin receptacles)	$4.90
SMG 50	Package of 20 each SMT KlipChip™ Adapters	$89.00
214-0283-00	Electrical Ground Contact	$1.90
214-4125-00	Electrical Contact Ground. TD	$2.65
344-0046-00	#6-32 Thread Alligator Ground Clip. TD	$2.95
352-0351-00	Probe Holder, self-adhesive back, black	$2.00



P6207, P6217, SD-14

P6207, P6217, SD-14

Part Number	Description	Price
013-0271-00	SMA Adapter to SD-14	$495
131-5308-00	4 Leg Ground Contact	$1.25
131-5309-00	1 Leg Ground Contact	$1.25
131-5482-00	Spring Ground Contact 2 each of 5 lengths	*1
200-3961-00	ESD ProtectiveProbe Tip Cover	*1



P6150

P6150

Part Number	Description	Price
013-0251-01	SMA Adapter to P6150	*1
016-1077-00	Spring Ground Contact, 2 each of 5 lengths	$15.00
131-4468-00	Ground Collar	$9.25
131-4473-00	1/4 in. Ground Lead	$1.20
131-4474-00	1 Leg Ground Contact	$1.15
131-4209-00	Probe Tip to CKT BD Adapter	$0.25

**1 Contact your local Tektronix representative for price information.*

TD
Product also available within 24 hours through TekDirect. Call 1-800-426-2200

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

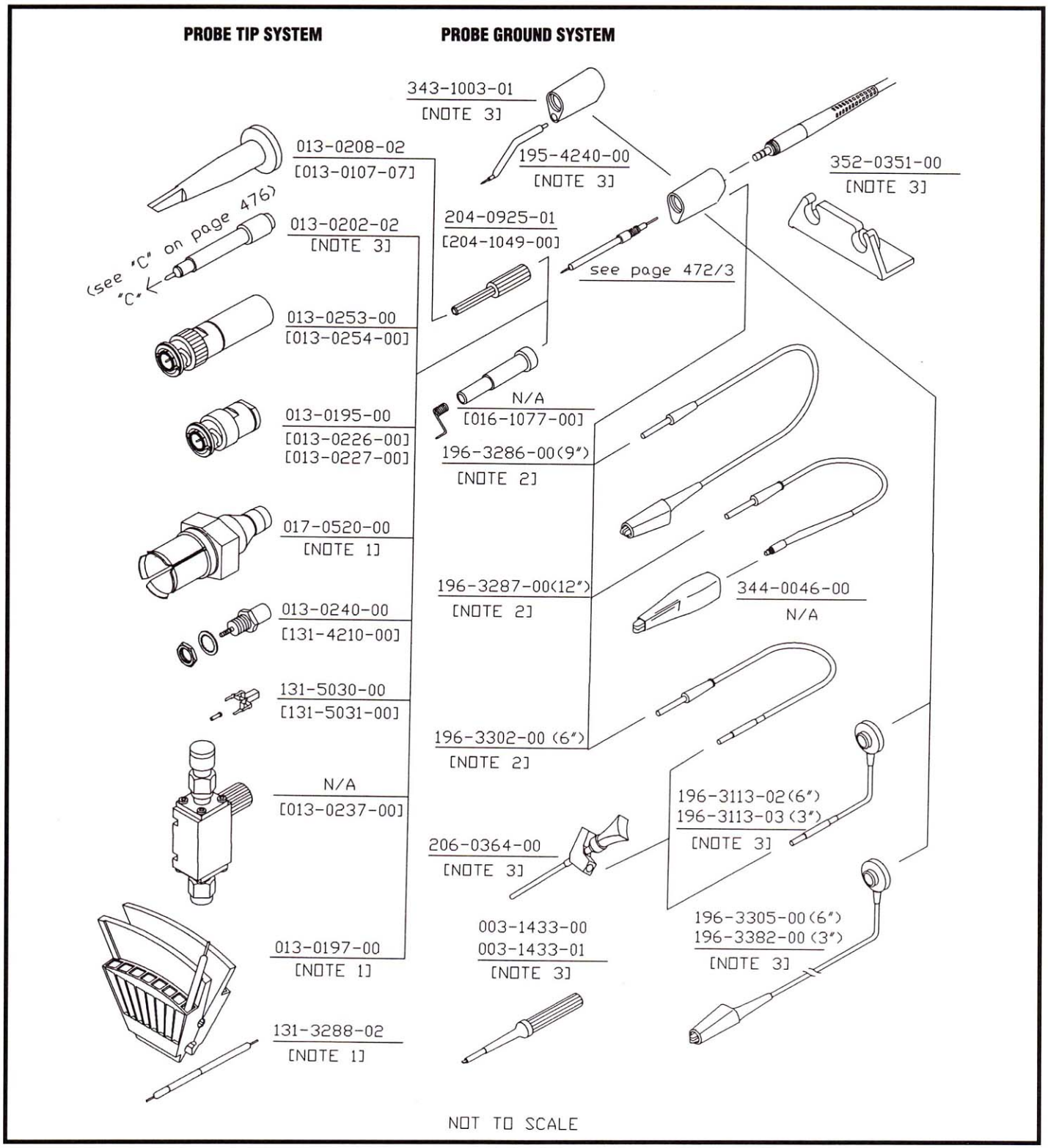
Probe Accessories

Probe Accessories Selection Guide

SUBMINIATURE AND COMPACT TIP SERIES:

Subminiature Tip – P6130, P6131, P6133, P6134, P6135, P6136, P6230, P6231
Compact Tip – P6053C, P6133 Opt. 25, P6134C, P6135A, P6136 Opt. 25, P6137, P6138, P6139A, P6156
P6562 – See next page.

Bracketed [ ] p/N's pertain to compact tip probes only.



Probe Accessories

ORDERING INFORMATION – SELECTION GUIDE

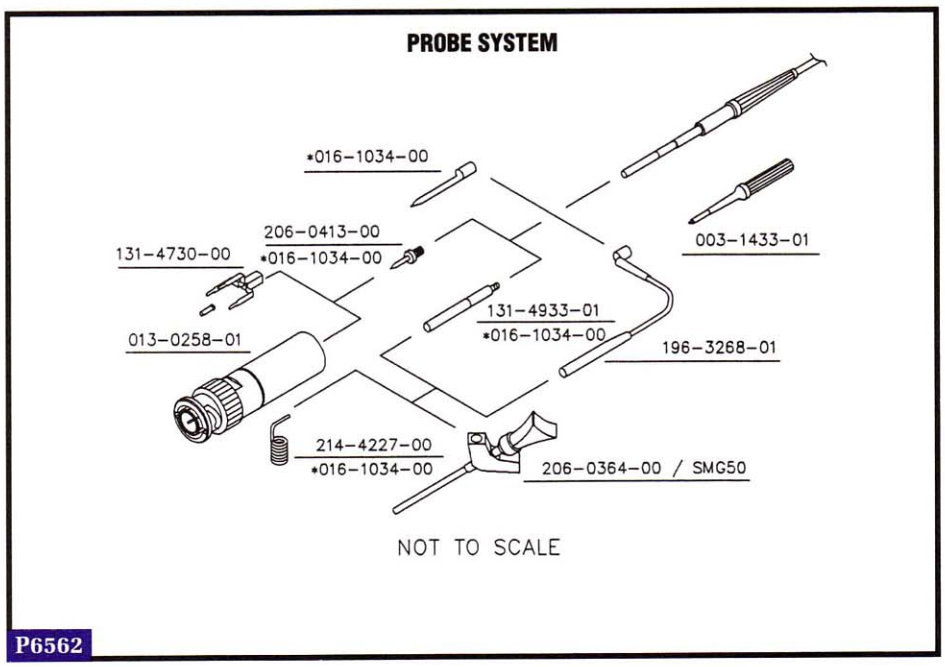
TIP SERIES SUBMINIATURE AND COMPACT

Note 1: Not compatible with Compact Tip Probes.

Note 2: Not compatible with P6137, P6156, P6134C, P6135A, and P6053C.

Note 3: Use same part number as subminiature probe.

Part Number	Description	Price
003-1433-00	Adjustment Tool for P601X/A, P612X, and P613X family	**$1.05**
003-1433-01	Package of 5 each of 003-1433-00, above	**$5.25**
013-0107-07	Retractable Hook Tip for Compact Tip Probes.	**$5.25**
013-0195-00	Subminiature Probe Tip to BNC Adapter.	**$12.25**
013-0197-00	KLIP-KIT (includes two 16-pin DIP Clips and four signal/ground pins)*1 .... TD	**$65.00**
013-0258-01	P6562 Subminiature Probe Tip to BNC Adapter, 50 Ω terminated	**$90.00**
013-0202-02	Subminiature/Compact to-Miniature Probe to Adapter (allows use of miniature probe tip accessories. See page 476) ..... TD	**$6.75**
013-0208-02	Retractable Hook Tip for Subminiature Tip Probes.	**$5.25**
013-0226-00	Compact Probe Tip to BNC Adapter. ..... TD	**$13.25**
013-0227-00	Compact probe tip to BNC 50 Ω termination adapter.	**$69.00**
013-0237-00	Compact probe tip to SMA adapter.	**$345.00**
013-0240-00	Subminiature probe tip Chassis mount test jack. . TD	**$6.50**
013-0253-00	Subminiature Probe Tip to BNC Adapter Thread Locking	*1
013-0254-00	Compact Probe Tip to BNC Adapter Thread Locking	*1
016-1077-00	Ground Tip Contact for Compact Tip Probes. 2 ea. five different probe tip to ground contact spacings.	**$15.00**
017-0520-00	Subminiature Probe Tip to GR 50 Ω termination adapter.	**$75.00**
131-3288-02	Signal/Ground Pins for KLIP-KIT (013-0197-00), (includes eight pins).	**$70.00**
131-4210-00	Compact Probe Tip Chassis Mount Test Jack.	**$6.50**



P6562

131-5030-00	Subminiature Probe Tip Circuit Board Test Points (pkg 25)	**$48.00**
131-5031-00	Compact Probe Tip Circuit Board Test Points (pkg 25)	**$48.00**
195-4240-00	Low Impedance Ground Contact.	**$2.90**
196-3286-00	8 in. Alligator Ground Lead	**$9.00**
196-3287-00	12 in. Slip On Ground Lead	**$10.25**
196-3113-02	6 in. Slip On Ground Lead	**$10.50**
196-3113-03	3 in. Slip On Ground Lead	**$8.50**
196-3302-00	6 in. Alligator Ground Lead (not compatible with P6137 or P6156).	**$13.50**
196-3305-00	6 in. Alligator Ground Lead	**$13.25**
196-3382-00	3 in. Alligator Ground Lead	**$14.00**
204-0925-01	Subminiature Probe Tip Attenuator Tip Cover.	**$1.45**
204-1049-00	Compact Probe Tip Attenuator Tip Cover.	**$1.10**
206-0364-00	SMT KlipChip™ Adapter	**$4.90**
343-1003-01	Ground Collar	**$3.00**
344-0046-00	#6-32 Thread Alligator Ground Clip ..... TD	**$2.95**
352-0351-00	Probe Holder, self-adhesive back, black	**$2.00**

P6562 PROBE

Product Number	Description	Price
SMG 50	Package of 20 each SMT KlipChip™ Adapters	**$89.00**
013-0258-01	Probe Tip to BNC Adapter 50 Ω terminated	**$90.00**
016-1034-00	Adapter Accessory Kit: Tips, Spring Adapter, Jack Tip Assembly, Low Inductance Ground Lead	**$35.00**
131-4730-00	SMT Probe Tip Circuit Board Test Points, pkg of 5	**$15.00**
131-4933-01	Jack Tip Assembly: 0.025 in. square pin socket, pkg of 5. Can be purchased as part of 016-1034-00	**$42.00**
196-3268-01	Ground Lead with 0.025 in. Receptacle, pkg of 5	**$40.00**
206-0364-00	SMT KlipChip™, 1 each	**$4.90**
206-0413-00	Replaceable Tip for P6562	**$4.10**
214-4227-00	Right Angle Square Pin Adapter	**$4.75**

**1 Contact your local Tektronix representative for price information.*

TD
Product also available within 24 hours through TekDirect. Call 1-800-426-2200

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

Probe Accessories Packs Test Leads, Cables

ORDERING INFORMATION – SELECTION GUIDE

ACCESSORY PACK/MINIATURE PROBE TIPS
Order 020-1724-00 ..... TD **$39.00**
Includes: Screwdriver (003-1433-00); Retractable Hook Tip (013-0107-06); Ground Cover (166-0404-01); 6 in. Ground Lead (196-3198-00); 5 in. Ground Lead (175-0124-01); 12 in. Ground Lead (175-0125-01); 3 in. Ground Lead (175-0263-01); SMT KlipChip™ (206-0364-00); Alligator Clip for #6-32 Thread (344-0046-00); IC Test Tip; 3.5 in. Ground Lead (195-6176-01); Spring Ground (214-4125-01).

ACCESSORY PACK/P613X COMPACT AND SUBMINIATURE
Order 020-1835-00 ..... TD **$85.00**
Includes: Screwdriver (003-1433-00); Retractable Hook Tip (013-0107-06); Retractable Hook Tip (013-0208-02); 2 in. Ground Lead (195-4240-00); 3 in. Ground Lead (196-3113-03); 6 in. Ground Lead (196-3113-02); 12 in. #6-32 Stud Ground Lead (196-3287-00); 8 in. Ground Lead (196-3286-00); SMT KlipChip™ (206-0364-00); Ground Collar (343-1003-01); Alligator Clip #6-32 thread (344-0046-00); 6 in. Ground Lead with 0.025 in. Receptacle (196-3302-00); 6 in. Ground Lead w/Alligator (196-3305-00).

TD
Product also available within 24 hours through TekDirect. Call 1-800-426-2200

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

ACCESSORY PACK FOR P612X PROBE TIPS (Not Shown)
Order 020-1836-00 ..... TD **$48.00**
Includes: Screwdriver (003-1433-00); IC Test Tip; Tip Insulator (166-0404-01);3.5 in. Ground Lead (195-6176-00); 6 in. Ground Lead (196-3302-00); 8 in. Ground Lead (196-3286-00); 12 in. Ground Lead (196-3287-00); Retractable Hook Tip (013-0107-06); Alligator Clip #6-32 Connector (344-0046-00); SMT KlipChip™ (206-0364-00); Spring Ground (214-4125-00).

Test Leads

ALM01
UL approved red and black test lead set with miniature size probe tips. Incorporates shrouded banana plugs and includes two retractable hook tips ... **$25.00**

ALM02
Red and black test lead set with miniature size probe tips. Non-shrouded banana plugs (photo inset) and includes two retractable hook tips. (Non-UL) ... **$25.00**

ALM03
Red and black test lead set (not shown) with miniature size probe tip for the red lead and alligator clip for the black lead. Non-shrouded banana plugs and includes one retractable hook tip. (Non-UL) **$40.00**

Cables

COAXIAL BNC CABLES

50 Ω

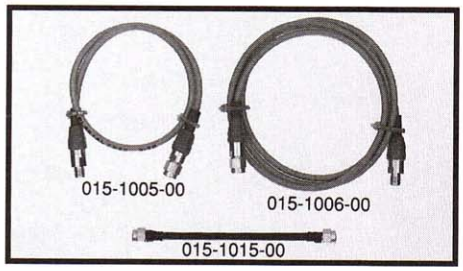
012-0208-00	10 in., male to male	$22.00
012-0076-00	18 in., male to male	$31.00
012-1342-00	24 in., male to male ..... TD	$55.00
012-1341-00	36 in., male to male	$45.00
012-0482-00	36 in., precision (1%) male to male	$35.00
012-0057-01	42 in., male to male	$28.00
012-0104-00	18 in., male to female	$30.00
012-0128-00	10 in., BNC male to BSM female	$30.00
012-0127-00	18 in., BNC male to BSM female	$40.00

75 Ω

012-1339-00	24 in., male to male	$45.00
012-1338-00	36 in., male to male	$45.00
012-0074-00	42 in., male to male	$31.00
012-1337-00	60 in., male to male ..... TD	$45.00

93 Ω

012-0075-00	42 in., male to male	*1



COAXIAL SMA (3MM) 50 Ω CABLES

General Purpose Flexible Cables

174-1364-00	12 in., male to male ..... TD	$33.00
174-1427-00	20 in., male to male ..... TD	$55.00
174-1428-00	60 in., male to male	$65.00

Precision, Flexible Delay Cables

015-1019-00	1 ns, male to female	$270
015-1005-00	2 ns, male to female	$305
015-1006-00	5 ns, male to female	$260
015-0562-00	1 ns, male to male	$430
015-0560-00	2 ns, male to male	$475
015-0561-00	5 ns, male to male	$565

Semirigid Delay Cables

015-1015-00	500 ps, 4.5, male to male	$35.00
015-1017-00	750 ps, male to male	$50.00

PATCH CORDS (Not Shown)

BNC to BNC, 18 in.

012-0087-00	Red	$16.25
012-0086-00	Black	$10.00

BNC to Banana Plug-Jack, 18 in.

012-0091-00	Red	$9.00
012-0090-00	Black	$9.00

Banana Plug-Jack to Banana Plug-Jack, 18 in.

012-0031-00	Red	$13.00
012-0039-00	Black ..... TD	$13.00

Pin-Jack to Pin-Jack, 0.08 in. dia-pin

012-0179-00	Red, 8 in.	$5.00
012-0181-00	Black, 8 in.	$5.00
012-0180-00	Red, 18 in.	$4.55
012-0182-00	Black, 18 in.	$6.00

INTERFACE CABLES (Not Shown)

GPIB

012-0991-01	1m, double-shielded ..... TD	$170
012-0991-00	2m, double-shielded ..... TD	$170
012-0991-02	4m, double-shielded	$260

Centronics

012-1250-00	8 ft. Male Centronics to PC 25-pin D ..... TD	$50.00
012-1284-00	9 ft. Male to Male	$33.00
012-0555-00	10 ft., 4695 to Terminal	$125

RS-232C

012-0911-00	10 ft. DB25 male – DB25 female, straight through	$100
012-1285-00	9 ft. DB25 male – DB25 female, null modem	$44.00
012-1298-00	9 ft. DB25 male – DB9 female, null modem ..... TD	$39.00
131-4923-00	DB25 male – DB25 male gender changer	$15.00

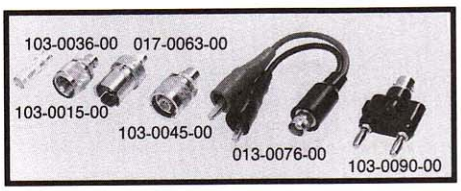
**1 Contact your local Tektronix representative for price information.*

Adapters, Connectors and Adapter Kits

ORDERING INFORMATION – SELECTION GUIDE

BNC ADAPTERS

103-0032-00	BNC male to UHF female	$8.50
017-0064-00	BNC male to GR	$140
103-0058-00	BNC male to N female (TD)	$15.50
103-0033-00	BNC male to binding post (TD)	$7.00
103-0035-00	BNC male to dual binding post (TD)	$20.00



103-0036-00	BNC female to BSM male	$19.00
103-0015-00	BNC female to UHF male (TD)	$6.00
017-0063-00	BNC female to GR	$80.00
103-0045-00	BNC female to N male (TD)	$17.00
013-0076-00	BNC female to Clip Leads (TD)	$49.00
013-0076-01	BNC female to EZ ball (TD)	$26.00
103-0090-00	BNC female to dual banana (TD)	$13.50

N STYLE ADAPTERS

017-0021-00	N male to GR	$165
017-0062-00	N female to GR	$115
103-0058-00	N female to BNC male (TD)	$15.50
103-0045-00	N male to BNC female (TD)	$17.00

3.5 MM ADAPTERS (NOT SHOWN)

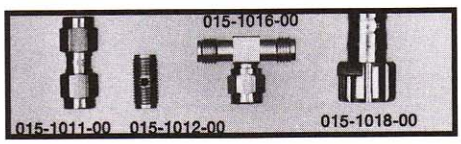
015-0551-00	Male to male	$330
015-0550-00	Female to female	$295
015-0552-00	Male to female connector saver*1	$245

SMA ADAPTERS (NOT SHOWN)

015-0572-00	SMA female to BNC male	$24.00
015-0554-00	SMA male to BNC female	$41.00
015-1007-00	SMA male to GR	$195
015-1008-00	SMA female to GR	$215
015-1009-00	SMA male to N-female	$55.00
015-0553-00	Threaded female to male slip on connector	$38.00
015-0549-00	Male to female connector saver*1	$185

BNC CONNECTORS

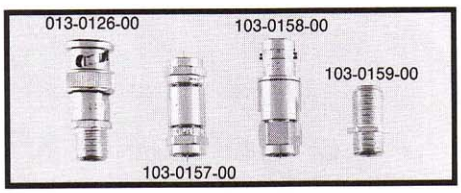
103-0028-00	BNC female to BNC female (TD)	$12.00
103-0029-00	BNC male to BNC male	$13.50
103-0030-00	BNC T (TD)	$14.00
103-0031-00	BNC elbow male to female	$12.75



SMA CONNECTORS

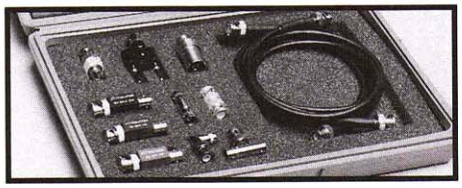
015-1011-00	SMA male to male	$28.00
015-1012-00	SMA female to female	$10.00
015-1016-00	SMA T	$44.00
015-1018-00	SMA male to BNC female	$12.25

**1 Used permanently installed on instrument to prolong life of instrument connector.*



MISC. CONNECTORS

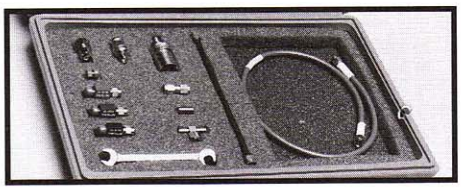
013-0126-00	Female to BNC male	$22.00
103-0157-00	Male to "F" male	*1
103-0158-00	Male to BNC female	$14.00
103-0159-00	Female to "F" female	$8.00



BNC ADAPTER KIT

AK01 BNC Adapter Kit **$440**

Includes: 50 Ω Feed-through termination 011-0049-01; 50 Ω 10X Attenuator 011-0059-02; 50 Ω, 5X Attenuator 011-0060-02; 50 Ω, 6 dB Attenuator 011-0069-02; 50 Ω, Coax Cable, 42 in. (2 each), 012-0057-01; GR to BNC Female Adapter 017-0063-00; BNC Female to BNC Female Adapter 103-0028-00; BNC "T" 103-0030-00; BNC elbow male to female 103-0031-00; BNC female to dual banana 103-0090-00; BNC male to BNC male 103-0029-00.



SMA ADAPTER KIT

AK02 SMA Adapter Kit **$1,080**

Includes: 4.5 in. Semi-Rigid Cable w/Male Connectors (015-0015-00); 1 m, Flexible, 50 Ω Cable w/Male Connectors (174-1341-00); 2X attenuator (015-1001-00); 5X Attenuator (015-1002-00); 10X Attenuator (015-1003-00); GR to SMA Female Adapter (015-1008-00); SMA Male to SMA Male Adapter (015-1011-00); SMA Female to SMA Female Adapter (015-1012-00); SMA "T" (015-1016-00); SMA Male to BNC Female (015-1018-00); 50 Ω Termination (015-1022-00); SMA Female to BNC Male Adapter (015-0572-00).

**1 Contact your local Tektronix representative for price information.*

(TD) Product also available within 24 hours through TekDirect. Call 1-800-426-2200

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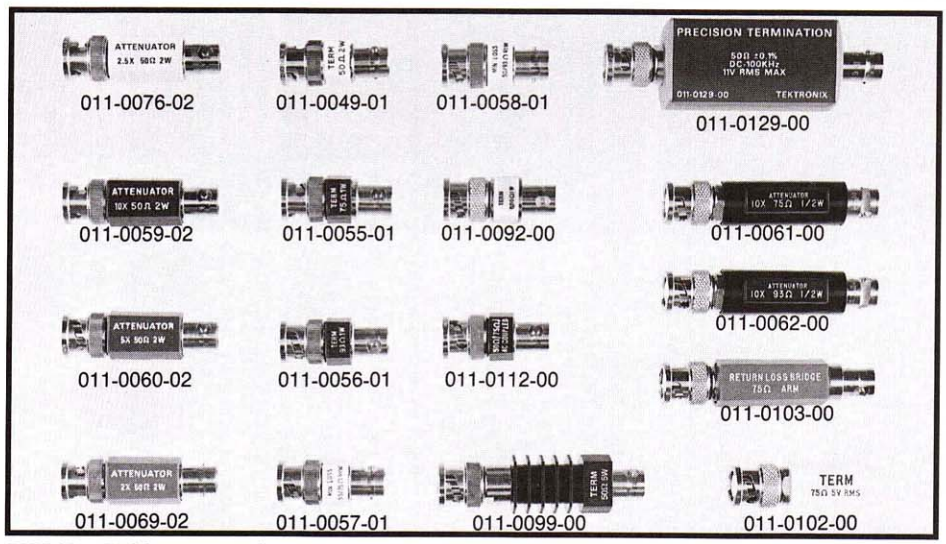
Attenuators

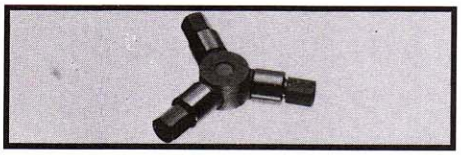
ORDERING INFORMATION – SELECTION GUIDE



BNC (See Table next page)

3.5 MM TERMINATIONS (NOT SHOWN)

Female 50 Ω	011-0149-00	**$1,625**
Female short-circuit	011-0150-00	**$275**
Male 50 Ω	011-0148-00	**$1,625**
Male short-circuit	011-0151-00	**$275**



50 Ω POWER DIVIDER

SMA female connector	015-0565-00	**$315**
SMA male connector	015-1014-00	**$300**
GR connectors	017-0082-00	**$1,095**

Designed for use in broad-band 50 Ω systems where the mismatch introduced by ordinary "Tee" connectors is undesirable. Load isolation is nominally 6 dB while the voltage attenuation ratio is nominally 2X (input to either load arm, other load arm terminated in a standard 50 Ω termination). Maximum VSWR on the 015-1014-00 is 1.50 from DC to 12.00 GHz and 1.90 from 12.01 to 18.00 GHz.

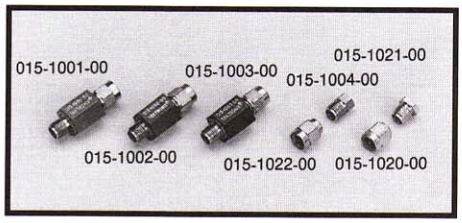
ACCESSORY HOUSING 011-0081-00 **$70.00**

Accessory housing without electrical components is useful for applications requiring special circuitry.

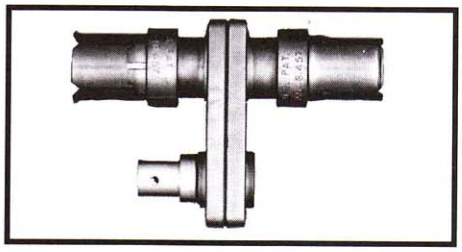
50 Ω COUPLING CAPACITORS

Coupling Capacitor SMA 015-1013-00 **$315**

The coupling capacitor is a short length of coaxial line with a disk capacitor (5000 pF SMA) in series with the inner conductor. High frequencies are transmitted with small reflection, but DC and low frequencies are blocked. Voltage rating is 200 V (015-1013-00).



SMA (See table next page)



CT-3 SIGNAL PICKOFF

CT-3 Signal Pickoff 017-0061-00 *1

The CT-3 Pickoff provides a convenient means of picking off a signal in a 50 Ω system.

Sensitivity – 10% of the voltage under test, into a 50 Ω load.

Decay Time Constant – 4.5 µs at 0 DC current.

Rise Time – <0.4 ns.

Frequency Response – 50 kHz to 875 MHz at 0 DC current.

Insertion Impedance – With 50 Ω termination is 1 Ω shunted by 4.5 µH, 2 Ω shunted by 4.5 µH without a 50 Ω termination.

VSWR – <1.2 at 1.5 GHz.

Voltage Rating – AT 0 VDC is 25 V RMS. 1 kV pulse peak.

**1 Contact your local Tektronix representative for price information.*

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

Attenuators/Terminations

ATTENUATORS/TERMINATIONS SELECTION GUIDE

BNC 50, 75, and 93 Ω (See photo next page)

	Type	Impedance (Ohms)	Z-Tol. (Ohms)	Atten.	Atten. (db)	Tol. (db)	Freq. (dc to) (Watts)	Avg. Power (Watts)	Peak Power	Max. VSWR	Price
011-0049-01	Feed-through termination	50	±1	NA	NA	NA	1 GHz	2	300	1.2-DC to 1 GHz TD	$35.00
011-0059-02	Attenuator	50	±1	10X	20	±0.4 to1 GHz ±0.6 1-2 GHz	2 GHz	2	500	1.1-DC to 1 GHz 1.2-1 to 2 GHz	$65.00
011-0060-02	Attenuator	50	±1	5X	14	±0.4 to1 GHz ±0.6 1-2 GHz	2 GHz	2	500	1.1-DC to 1 GHz 1.2-1 to 2 GHz	$50.00
011-0069-02	Attenuator	50	±1	2X	6	±0.3 to1 GHz ±0.5 1-2 GHz	2 GHz	2	500	1.1-DC to 1 GHz 1.2-1 to 2 GHz TD	$65.00
011-0076-02	Attenuator	50	±1	2.5X	8	±0.3 to1 GHz ±0.5 1-2 GHz	2 GHz	2	500	1.1-DC to 1 GHz 1.2-1 to 2 GHz	$53.00
011-0099-00	Feed through termination	50	±0.5	NA	NA	NA	200 MHz	5		1.1-DC to 100 MHz 1.2-100 to 200 MHz	$65.00
011-0055-01	Feed through termination	75	±1	NA	NA	NA	100 MHz	1	300	1.1-DC to 100 MHz TD	$44.00
011-0056-01	Feed through termination	93	±1	NA	NA	NA	100 MHz	1	300	1.1-DC to 100 MHz	$39.00
011-0057-01	Min. loss attenuator	50-75		2.3X	7.2	±0.5	100 MHz	.5		1.1-DC to 100 MHz	$50.00
011-0058-01	Min. loss attenuator	50-93		2.3X	7.2	±0.5	100 MHz	1.2		1.1-DC to 100 MHz	$47.00
011-0061-00	Attenuator	75		10X	20			.5			$49.00
011-0062-00	Attenuator	93		10X	20			.5			$40.00
011-0092-00	Feed through termination	600	±6	NA	NA	NA	1 MHz	1			$40.00
011-0112-00	Min loss attenuator	75-50						2		(AC coupled)	$85.00
011-0129-00	Feed through termination	50	±0.05	NA	NA	NA	100 kHz				$185
011-0102-00	Coax termination	75	±0.5	NA	NA	NA		.5			$31.00
011-0103-00*1	Return loss bridge	75	±0.5	NA	NA	NA					$30.00

**1 011-0103-00 red color body; 011-0103-01 green color body; 011-0103-02 white color body.*

SMA (3mm) 50 Ω (see photo on next page)

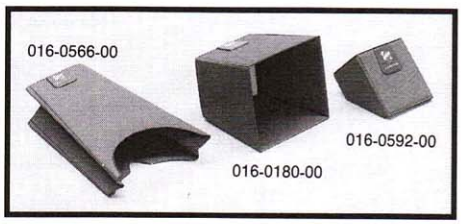
	Type	Impedance (Ohms)	Z-Tol. (Ohms)	Atten.	Atten. (db)	Tol. (db)	Freq. (dc to) (Watts)	Avg. Power (Watts)	Peak Power	Max. VSWR	Price
015-1001-00	Attenuator	50	±1.0	2X	6	±0.3	18 GHz	1	500	1.15-DC to 4 GHz 1.25-4 to 12.4 GHz 1.35-12.4 to 18 GHz	$185
015-1002-00	Attenuator	50	±10	5X	14	±0.5	18 GHz	1	500	1.15-DC to 4 GHz 1.20-4 to 8 GHz 1.25-8 to 12.4 GHz 1.35-12.4 to 18 GHz	$175
015-1003-00	Attenuator	50	±1.0	10X	20	±0.5	18 GHz	2	500	1.15-DC to 4 GHz 1.20-4 to 8 GHz 1.25-8 to 12.4 GHz 1.35-12.4 to 18 GHz	$195
015-1004-00	Termination (female)	50	±0.5	NA	NA	NA	18 GHz	0.5	200	1.05-DC to 4 GHz 1.10-4 to 12.4 GHz 1.15-12.4 to 18 GHz	$75.00
015-1020-00	Short-circuit termination (male)	0		NA	NA	NA	18 GHz	NA	NA		$27.00
015-1021-00	Short-circuit termination (female)	0		NA	NA	NA	18 GHz	NA	NA		$31.00
015-1022-00	termination (male)	50	±0.5	NA	NA	NA	18 GHz	0.5	100		$41.00

TD
Product also available within 24 hours through TekDirect. Call 1-800-426-2200

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

Viewing Hoods

ORDERING INFORMATION – SELECTION GUIDE



The viewing accessories normally mount on the instrument graticule cover. Some may fit camera-mounted bezels. If you intend using a camera on your instrument, check with your Tek Sales Engineer for bezel-viewer compatibility.

	Part No.	Price
Folding Binocular –		
For 2200 Series 2445A/B, 2465A/B, 2467B, 271X Family, 434, 455, 464, 466,465B, 475, 475A	016-0566-00	**$24.00**
For 422, 453A, 454A, 485, 491	016-0082-00	**$21.00**

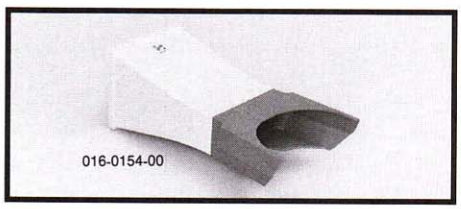
Collapsible –
To reduce reflections and glare under high ambient light. Blue vinyl, folds flat for storage. For 2200 Series, 2445A/B, 2455A, 2465A/B, 2467B, 271X Family, 432, 434, 455, 465/B, 475, 464, 466 (polarized) 016-0180-00 **$80.00**

For 2200 series, 2445A/B, 2465A/B, 2467B, 271X Family, 464, 466, 455, 465, 465B, 475 (non-polarized) 016-0592-00 **$16.50**

For 422, 453, 454A, 485, 491 (non-polarized) 016-0274-00 **17.00**

Folding –
For 576 016-0259-00 **$25.00**

For 577, 5000, 7000, 11000 Series 016-0260-00 **$55.00**



Non-collapsible –
For older Tek 5-in. Oscilloscopes 016-0001-01 **$240**

Molded –
Gray polystyrene with polyurethane eyepiece.
For 5000 and 7000 series, 528, 577 016-0154-00 **$105**
For 576 016-0153-00 **$65.00**

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

Light Filters

ORDERING INFORMATION – SELECTION GUIDE

Cathode-Ray Tube Light Filters

SELECTION GUIDE

Instrument*1	Color	Part Number	Price
200 Series	Blue	378-0691-00	**$5.95**
324/335	Blue	378-2016-01	**$2.25**
490	Amber	378-0115-01	**$3.30**
	Gray	378-0115-02	**$6.00**
	Blue	378-0115-00	**$3.10**
434	Blue	378-0678-01	**$18.25**
455/465M	Blue	337-2122-00	**$8.50**
465/465B	Blue	337-1674-00	**$10.00**
475	Clear	337-1674-01	**$10.00**
464/466	Smoke-grey filter	337-1674-07	**$15.25**
540/550 Series	Smoke-gray*2	378-0567-00	*3
	Green	378-0568-00	**$19.00**
565/575	Blue	378-0569-00	**$19.00**
	Amber	378-0570-00	*3
576	Blue*2	378-0616-00	**$13.75**
603/604	Clear (603*2)	337-1440-00	**$5.25**
	Green	337-1440-01	**$5.75**
	Amber	337-1440-02	**$15.75**
	Blue	337-1440-03	**$15.50**
	Gray	337-1440-04	**$15.50**
	Graticule (8 x 10 div)	331-0303-00	**15.00**
605/606/607	Blue	337-1674-00	**$12.00**
	Graticule	337-1674-10	**$11.00**
	Clear Shield	337-1674-13	**$16.25**
	Gray*2	337-1674-06	**$5.50**
	Graticule (8x10 div)	331-0391-00	**$9.00**
608	Amber	378-0704-00	**$10.00**
	Graticule*2	337-2126-02	**$10.00**
2200 Series	Blue*2	337-2775-00	**$5.00**
	Clear	337-2775-01	**$2.40**
	Gray w/TV Graticule	035-0175-00	*3
2300 Series	Blue Implosion Shield*2	337-2760-00	**$2.25**
	Clear Implosion Shield*2	337-2781-00	**$4.40**
2400 Series	Blue*2	378-0199-03	**$4.90**
	Clear Implosion Shield*2	378-0208-00	**$2.05**
271X Family	Smoke Gray	337-2775-02	**$11.00**
5100 & 5400 Series (except 5441)	Clear	337-1440-00	**$5.25**
	Green	337-1440-01	**$5.75**
	Amber	337-1440-02	**$15.75**
	Blue	337-1440-03	**$15.50**
	Gray	337-1440-04	**$15.50**
5441	Clear*2	337-1674-01	**$9.00**
	Gray	337-1674-07	**$15.25**
	Graticule (8x10 div)	331-0391-00	**$9.00**
7603	Blue	378-0684-00	**$10.50**
	Amber	378-0684-01	**$7.00**
	Gray	378-0684-02	**$9.25**
	Green	378-0684-03	**$14.25**
	Spectrum Analyzer Graticule	337-1439-01	**$9.75**
	Blue Implosion Shield*2	337-1700-01	**$17.50**
	Clear Implosion Shield	337-1700-04	**$7.25**
7613/7623/7623A/7633	Spectrum Analyzer Graticule	378-0625-07	**$18.25**
	Green (UV)	378-0625-08	**$7.25**
7844/7313	Blue*2	378-0625-00	**$13.50**
7700 Series/7613/7623/7100 Series/7900	Amber	378-0625-01	**$11.50**
	Gray	378-0625-02	**$14.25**
	Green	378-0625-03	**$16.75**
	Gray TV Graticule NTSC	378-0625-06	**$10.25**
	Clear Shield Spectrum Analyzer Graticule	337-1159-02	**$18.50**

CRT MESH/EMC Filters

The mesh filter improves display contrast for instrument viewing under high ambient light conditions. A fine metal screen with a matte black surface is utilized to reduce light reflections. Although light transmission from the CRT is reduced to approximately 28%, the high attenuation of external reflections allows viewing low intensity displays in room light or other bright surroundings.

The mesh filter also serves as an EMC filter. Installed on the instrument, the metal frame of the filter is grounded, providing effective filtering of the EMC spectrum.

Instrument*1	Part Number	Price
314/326/335	378-0063-00	**$65**
432/434	378-0682-00	**$65**
422/491/453A/454A/485	378-0648-00	**$70**
465/465B/475/464/466/434	378-0726-01	**$120**
7400/7603	378-0696-00	**$95**
7100/7500/7700/7800/7900Series/7613/7623/A/7633	378-0603-00	**$125**

*1 *For both cabinet and rackmount instruments unless rackmount version is listed.*

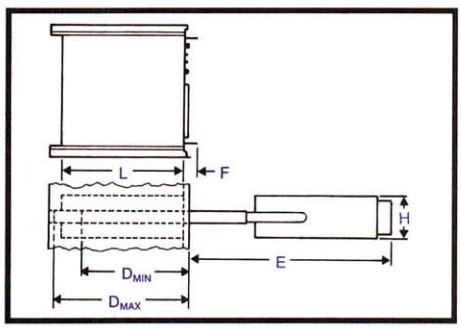
*2 *Standard filter supplied with instrument.*

*3 *Contact your local sales representative.*

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

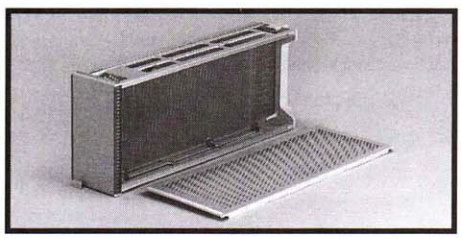
Rackmount Kits

ORDERING INFORMATION – SELECTION GUIDE



Dimensions – Exclusive of Plug-in Units and Probes

Symbol	Definition
H	Height of front panel
L	Rack front to rearmost permanent fixture excluding cables
F	Back of front panel to foremost protrusion
E	Maximum forward clearance with instrument out and horizontal
D Min	Minimum mounting depth from front mounting rail to rear mounting rail
D Max	Maximum mounting depth from front mounting rail to rear mounting rail



BLANK PLUG-IN CHASSIS
Available for all Tektronix mainframes. The 11000 Series provides a blank plug-in only. The 7000 Series includes a bare printed circuit board.

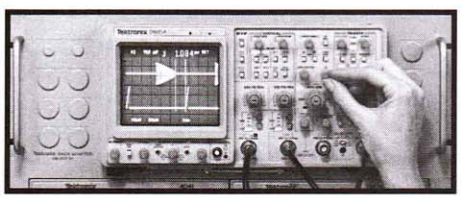
11000 Series	016-0829-00	**$160**
7000 Series	040-0553-04	**$230**
5000 Series	040-0818-04	**$145**
TM 500 Series	040-0652-06	**$135**

BLANK PANEL
When operating the 5000/7000 Series mainframes or the TM500/TM 5000 Series mainframes with less than a full complement of plug-ins, the blank panel may be used to cover an unused compartment. The panel for the 7000 Series is also good for EMC Shielding.

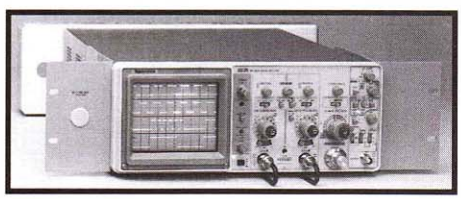
7000 Series	016-0155-00	**$110**
5000 Series	016-0452-01	**$85**
TM 500/TM 5000 Series	016-0195-05	**$47**

PLUG-IN STORAGE COMPARTMENT
The plug-in storage compartment provides storage space for probes, cables, "tees", accessories, and small tools. Inside dimensions: 250 mm long x 51 mm wide x 106 mm high (9-7/8 x 2 x 4 1/4 inches).

Plug-in Storage Comp.	016-0362-02	**$90**



Typical 2400 Series Rackmount



Typical 2200 Series Rackmount

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

Rackmount Kits

RACKMOUNT KIT SELECTION GUIDE

		H		L		F		E		D Min.		D Max.	
Instrument	**Part Number**	**in.**	**cm**	**in.**	**cm.**	**in.**	**cm**	**in.**	**cm**	**in.**	**cm**	**in.**	**cm**
DSA 601, DSA 602, 1201/A, 11301/A, 11302/A, 11401, 11402/A, 11403	040-1279-00 040-1214-03	12.25	31.1	24.3	61.7	2.4	6.1	31.7	80.5	14.63	37.2	27.75	70.49
11801, 11802, CSA 803, SM11	040-1214-00	8.75	22.3	21.6	55.0	–	–	–	–	14.63	37.2	27.75	70.49
7704A, 7104, 7934, 7854, 7904A	040-0611-01	15.75	40.0	21.63	54.9	1.25	3.18	30.48	77.4	–	–	–	–
7704A, 7104, 7934, 7854, 7904A	040-0560-00*1	22.0	55.9	21.9	55.6	1.98	5.0	–	–	–	–	–	–
7000 Series Plug-in Storage Cabinet	437-0126-03	5.25	13.3	–	–	–	–	–	–	–	–	–	–
5100, 5400 Series	040-0583-03	5.25	13.3	19.0	48.3	1.1	2.8	24.6	62.5	–	–	–	–
279X Family	016-0844-01	8.75	22.3	17.8	45.2	–	–	–	–	–	–	–	–
278X Family	016-1019-00	8.75	22.3	17.8	45.2								
271X Family	016-0901-00	5.25	13.3	16.3	41.4	1.84	4.67	–	–	–	–	–	–
271X Family	016-0897-00*1	7.0	17.8	18.4	46.7	4.67	11.9	–	–	–	–	–	–
2400 Series (with DV or DMM Opt.)	016-0805-00	8.75	22.3	18.3	46.5	1.8	4.5	24.8	62.9	12.8	32.5	26.8	68.1
2400 Series (w/o DV or DMM Opt.)	016-0825-01	7.0	17.8	18.3	46.5	1.8	4.5	24.8	62.9	12.8	32.5	26.8	68.1
2402 TekMate™	016-0971-00	3.5	8.9	18.0	45.7	1.8	4.5	24.5	62.2	11.0	27.9	23.0	58.4
2245A, 2246A, 2247A	2240FIR	7.0	17.8	18.3	46.5	2.2	5.6	24.8	62.9	12.8	32.5	24.5	62.2
2335	016-0468-00	5.25	13.3	16.3	41.4	1.8	4.5	–	–	7.5	19.1	24.5	62.2
2236, 2236A	016-0015-00	5.25	13.3	16.3	41.4	1.8	4.5	–	–	7.5	19.1	24.5	62.2
2235 Opt. 01	016-0833-00	5.25	13.3	16.3	41.4	1.8	4.5	–	–	7.5	19.1	24.5	62.2
2235A	016-1062-00	5.25	13.3	16.3	41.4	1.8	4.5	–	–	7.5	19.1	24.5	62.2
2220, 2221, 2224, 2230, 2232	016-1003-00	5.25	13.3	16.3	41.4	1.8	4.5	–	–	7.5	19.1	24.5	62.2
2213A, 2215A	016-0466-00	5.25	13.3	16.3	41.4	1.8	4.5	–	–	7.5	19.1	24.5	62.2
2211	016-1023-00*2	5.25	13.3	16.3	41.4	1.8	4.5	–	–	7.5	19.1	24.5	62.2
2201, 2205, 2225, 2815	016-0819-02*2	5.25	13.3	16.3	41.4	1.8	4.5	–	–	7.5	19.1	24.5	62.2
1240, 1241	016-0789-00	8.75	22.3	17.75	45.1	1.13	2.9	–	–	–	–	–	–
1230	1230F05	8.75	22.3	17.75	45.1	1.13	2.9	–	–	–	–	–	–
490 Series	016-0844-01*1	8.75	22.3	17.75	45.1	4.7	11.9	–	–	–	–	–	–
DAS9100	016-0463-00	8.75	22.3	23.5	59.7	0.75	1.9	26.5	67.3	23.38	59.4	27.3	69.5
DAS9200	016-0845-00	10.5	26.7	23.5	59.7	0.63	1.6	26.5	67.3	23.38	59.4	27.3	69.5
91HS8, 92HS8	016-0884-00	3.5	8.9	23.5	59.7	0.75	1.9	26.5	67.3	23.38	59.4	27.3	69.5
TM5006, TM506A	040-0982-00	7.0	17.8	18.0	45.7	–	–	–	–	–	–	–	–
TM5003	040-1257-00	7.0	17.8	18.0	45.7	–	–	–	–	–	–	–	–
TM5003 to 4041	040-0984-01	7.0	17.8	18.0	45.7	–	–	–	–	–	–	–	–
Two TM503s side by side	040-0616-02	5.3	13.5	16.5	41.9	1.1	2.8	24.6	62.5	–	–	–	–
TM503 with 1/2 Rackwidth Adapter	040-0617-02	5.3	13.5	16.5	41.9	1.1	2.8	24.6	62.5	–	–	–	–

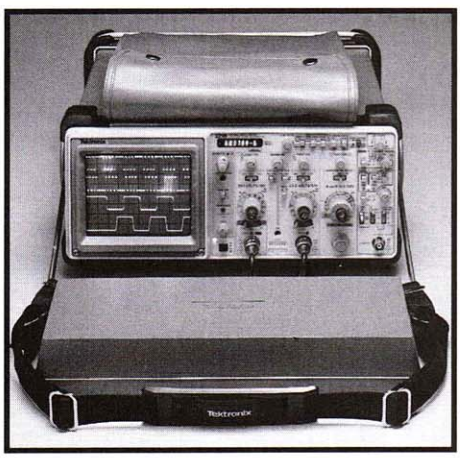
**1 Cradle mount to rackmount a cabinetized instrument.*

**2 For the 2211, 2201, 2225, 2205 oscilloscopes, and the 2815 Opto-Electronics scope when ordered with a rackmount kit (Option 1R) from the factory, the front feet of the instrument are removed. This reduces instrument height by one-half inch and cannot be reversed. When a field retrofit rackmount kit is installed, the instrument feet will remain integral to the instrument.*

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

Instrument Travel
Accessories

ORDERING INFORMATION – SELECTION GUIDE



Portable Oscilloscope

Travel Line Package

AVOID SCOPE DAMAGE AND IMPROVE PORTABILITY

- Impact-Resistant Packaging
- Pouch and Cover
- Carrying Strap
- Rubber Shock-absorbing Bumpers

Now give your 2200 Series instrument the added protection often necessary when used in rough environments. The Travel Line package provides protection from impacts along the front and rear of the instrument. The rear bumper is designed to provide a wider base to set the instrument on and reduces the potential of tip over when standing vertically. Plus it has a handy cord wrap.

The high-quality rubber moldings offer long life and are resistant to cracking and becoming brittle with age. The rubber composition provides excellent desk bench and inclined plane grab so there is no worry about instrument slippage.

A front panel protective cover and an accessory pouch for carrying probes and documentation is also included plus a convenient carrying strap for hands-free operation and transport.

The Travel Line Package can be ordered at the time of purchase or as a field retrofit kit (available on 2235A, 2236A, 2221, 2224, and 2232).

TRAVEL LINE PACKAGE

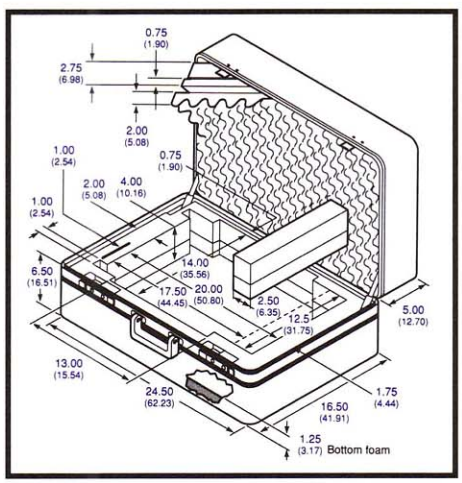
Order Opt. 33 for specific instrument.

2235A, 2236A – Includes rubber molding, accessory pouch, front panel cover, carrying strap.		**$295**
2221, 2224, 2232 – Includes rubber molding, carrying strap.		**$295**

TRAVEL LINE PACKAGE CONVERSION KIT

Includes: Replacement cabinet and rear cover with the rubber moldings installed.

2235A	040-1188-03	**$360**
2236A, 2221, 2224, 2232	040-1187-03	**$200**



016-0792-01 (shown)

Portable Instrument Transit/Carrying Cases

SPECIAL PROTECTION FOR TRANSPORTING AND SHIPPING PORTABLE INSTRUMENTS

- High Strength
- Foam Padding
- Custom Fit

Rugged transit cases molded of high strength glass-epoxy. Protects your instruments from hostile environments, shock, vibration, moisture, and impact. Recommended for shipping or transporting your instruments.

Adjustments can be made to the internal padding of the 016-0792-01 to accommodate a wide variety of portable instruments and accessories.

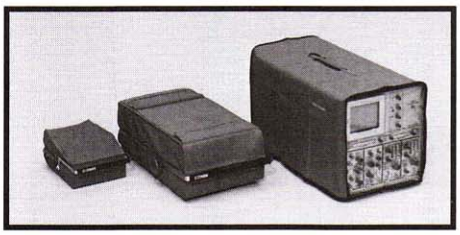
Hard Sided Case		
271X Family	016-0792-02	**$460**
2400 Series, 2200 Series	016-0792-01	**$380**
278X, 279X Family OF150, OF235	016-0658-00	**$990**
TM 503A	016-0565-01	**$920**
TM 504	016-0608-00	**$805**
TM 515	016-0643-00	**$850**
C-50 Series	016-0177-00	*1
Soft Sided Case		
271X Family	016-1158-00	**$120**
278X, 279X Family OF150, OF235	016-0659-00	**$155**
HC100	016-0707-00	*1
Carrying Strap		
2200/2300 Series, 271X Family	346-0199-00	**$22**
Accessory Pouch		
271X Family	016-0677-02	**$75**

**1 Contact your local Tektronix representative for price information.*

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

Instrument Travel
Accessories

ORDERING INFORMATION – SELECTION GUIDE



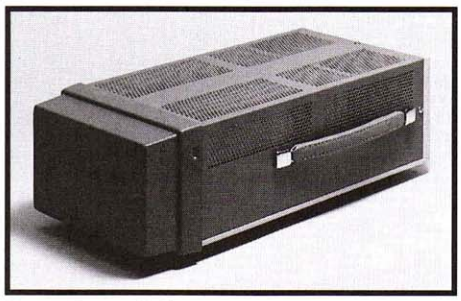
Complete Covers

Portable Instrument Protective Covers

- Custom Fit
- Waterproof Vinyl for Complete Enclosure of High Impact Plastic for Front Panel Enclosure

The cover provides protection for the instrument during transport or storage. Made of waterproof vinyl, the covers are available for both laboratory and portable instruments. The covers for 5000/7000 Series have clear vinyl frontal areas.

7704A/7900/7854/7104	016-0531-00	**$15**
7300/7400/7600 Series	016-0192-01	**$24**
5000 Series	016-0544-00	**$18**
2400 Series	016-0720-00	**$34**
2200 Series	016-0848-00	**$18**
200 Series	016-0512-00	**$28**
465/465B/475/485	016-0554-00	*1
453A/454A/491	016-0074-01	*1
434/464/466	016-0365-00	**$37**
326	016-0532-00	*1
314/335	016-0612-00	**$135**
TM 504	016-0621-00	**$45**
TM 503	016-0620-00	**$35**



Front Covers Only

Front Covers

Snap-on front cover, molded of high-impact plastic, is available for most portable oscilloscopes, spectrum analyzers, and TM 500/5000 mainframes.

2400 Series	200-3199-01	**$10.50**
2245A, 2246A, 2247A	200-3232-00 TD	**$11.75**
2235A, 2236A/271X Family	200-2520-00 TD	**$12.25**
2201, 2205, 2211, 2225	200-3397-00 TD	**$18.50**
TM 506	200-1728-00	**$24**
TM 504	200-1727-00	**$20**
TM 503A	200-3554-00	**$29**
1700 Series	200-3897-01	**$16.25**

**1 Contact your local Tektronix representative for price information.*

TD
Product also available within 24 hours through TekDirect. Call 1-800-426-2200

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

Television Products

Representing a first in automated camera measurements, the VM 700A Video Measurement Set simplifies several key camera evaluation methods for both tube and CCD television cameras. The VM 700A Option 21 camera measurements package provides digital measurements and utilizes industry-standard charts. It is available in NTSC or PAL standards.

Setting a new standard for price/performance in combination monitors, Tektronix introduced its new platform of analog video waveform/vector monitors. The 1740A offers the lightest weight, largest feature set, and longest warranty of any product in its class – three years. The 1750A contains all the features of the 1740A plus SCH and color frame verification capabilities. The 1760 is designed for composite/component mixed format applications. All the monitors provide eight video inputs, stereo audio phase/amplitude displays, cursors, and intuitive user interfaces.

Several new introductions for cable customers currently provide the broadest product offering for CATV test and measurement equipment. Tektronix has the products, service, and education conveniently packaged to help customers maximize their time and potential. A full range of equipment is available for baseband and RF measurements, in manual or automated applications.

A comprehensive line of low-cost generators, synchronizers, and VITS inserters has been added to the list of new products. These application-specific products broke significant price/performance barriers while maintaining Tektronix quality.

With digital implementation and expansion in video environments, and research and testing of high definition formats, Tektronix introduced several products to accommodate multiformat facilities. The 1735 HD is a new multiformat HD waveform monitor. The SPG 1000 is a new master sync generator for high definition systems, and the DAC 422 is a precision digital-to-analog converter. The 1730 D Series Digital Waveform Monitor and a series of digital and HDTV generators complete the product line.

CONTENTS

MEASUREMENTS SETS

VM 700A, Teletext Measurements 492
VM 700A Camera Meas, Component Meas, VMREMGR, VMBKUP, VMT 493
1780R, 1781R 493

SIGNAL MONITORS/VECTORSCOPES

1710B, 1711B 494
1720, 1721, 1725 494
1720 SCH, 1721 SCH 494
1730, 1731, 1735 494
1730 D, 1731 D 494
1735 HD 495
1740A, 1750A, 1760 Series 495
WFM 300A 495

GENERATORS/INSERTERS

DAC 422 496
Serial Digital Video Interface 496
TSG 170D 496
TSG 273 496
TSG 422 496
TSG 100, TSG 111 497
TSG 120, TSG 121, ...497
TSG 130A, TSG 131A 497
TSG 200, TSG 202 497
TSG 271 498
TSG 170A 498
1910 498
TSG 300, TSG 370, TSG 371 499
TSG 1050, TSG 1125, TSG 1250 499
SPG 1000 499
PE1000 499
TSG 1001 500
TPG-625 500
VITS 100, VITS 200, VITS 201 500

SYNCHRONIZERS

VS 210, VS 211 501
110-S, 118-AS 501

AUDIO

751, PC 751, 728D, 728E 502
AVC-20 502
760A, 760D, 760N, ...503
ASG 100 503

RF

1705 A 504
1450-1, 1450-2, 1450-3A 504
TDC 504
TDC-10 504
2714 504
2721, 2722 504

Television Products
Measurement Sets

Emmy Award Winning VM 700A Automatic Video Measurement Set

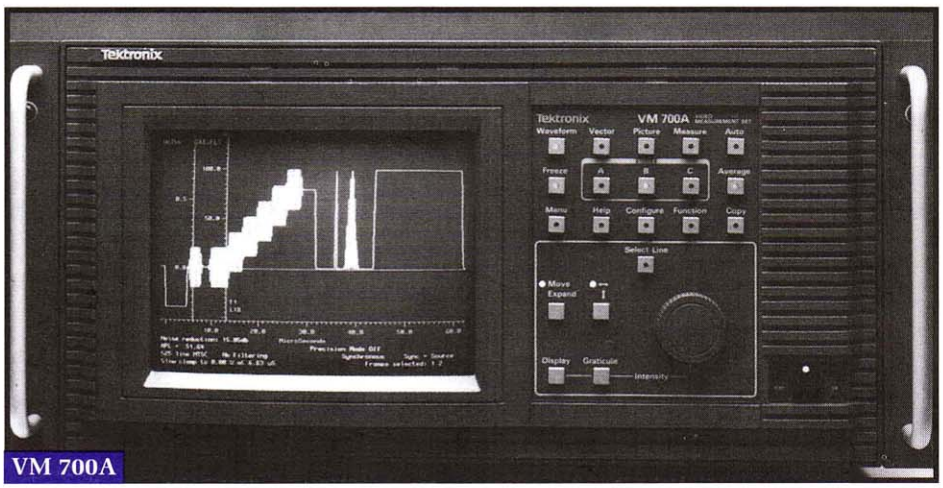
Teletext Measurements

Camera Measurements

Component Measurements

Remote Graphics

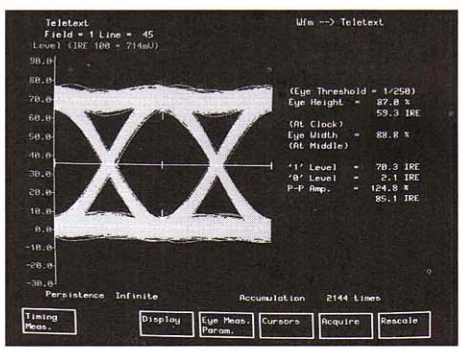
- VM 700A
  - –Opt. 20
  - –Opt. 21
  - –Opt. 30
- VMREMGR
- VMBKUP
- VMT
- 1780R/1781R



VM 700A

VM 700A

- Many capabilities in one instrument
  - Digital waveform monitor
  - Digital vectorscope
  - Group delay and frequency response
  - Noise measurement set
  - Automatic measurement set
- Auto Mode
  - Unattended monitoring of NTSC or PAL video signals from studios, STLs, earth stations, and transmitters
  - User-specified limits
- Measure mode provides graphic display of measurements
  - K factor
  - Differential gain and phase
  - Chrominance to luminance delay
  - Noise spectrum
  - Group delay with (Sin x)/x
  - Color bars
  - Relative-to-reference on most measurements
- Three input channels
- Averaging on most measurement modes
- Picture mode for source ID
- Hardcopy for analysis and documentation
- Remote control operation
- Automatic measurement of short duration audio test sequence
- Measure frequency response, distortion, phase, crosstalk, and other important audio parameters



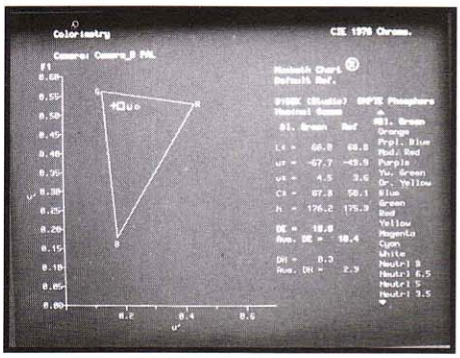
VM 700A VIDEO MEASUREMENT SET Opt. 20 Teletext Measurements

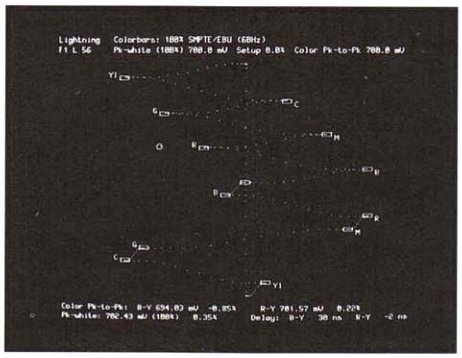
- Provides numerical results
  - Eye height
  - Eye width
  - Data levels (logical "0" and logical "1" levels)
  - Start of data code
  - Number of run-in bits
- Provides graphical displays
  - Eye height with variable persistence
  - Eye height with grading
  - Amplitude histogram
  - Teletext timing
- Multiple clock frequencies
  5.727272 MHz for System M (NTSC)
  6.9375 MHz for System B/G/I (PAL)
- Cursors for manual measurements

Television Products

Measurement Sets

Camera Meas.	VMBKUP
Component Meas.	VMT
VMREMGR	1780R
	1781R





NEW VM 700A Option 21
Camera Measurements

- Significantly simplifies key measurements of camera performance
- Compatible with NTSC or PAL cameras
- Automates pre-purchase evaluation and comparison of cameras
- Reduces time spent on acceptance testing, routine maintenance and operational adjustments
- Uses industry standard charts
- Camera matching simplified with relative-to-reference mode
- Ten key measurements:
  - Colorimetry
  - Fixed Pattern Noise
  - CDD Defects
  - Frequency Response
  - Gamma
  - Geometry/Registration
  - Detail
  - Shading
  - Frequency Response with Aliasing
  - Vertical Smear

VM 700A Option 30
Component Measurements

- Provides numerical results for:
  - relative timing of B-Y and R-Y
  - Relative amplitude of B-Y and R-Y
  - Peak to peak amplitude for B-Y and R-Y
  - Peak white amplitude
- Compatible with SMPTE/EBU, Betacam®, and MII Formats
- Numerical results in all measurements
- Level meter displays amplitude of all three channels simultaneously
- Configurable for Y/R-Y/B-Y or GBR formats
- Full complement of component analog video measurements and displays

VMREMGR
VM 700A Remote Graphics Software

- Display VM 700A graphics on a remote PC
- Perform front panel operations via mouse
- Issue remote commands
- Terminal operations

VMBKUP
VM 700A Backup and Remote Control Software

- Backup or restore sets of measurement configuration files, reference measurement files and function key definitions
- Perform individual file and directory operations on both the connected personal computer and VM 700A
- Use to restore backed up files to VM 700A after upgrade
- Control the VM 700A from a personal computer
- Use Serial Line Internet Protocol (SLIP©) for data transfer over RS-232C connection

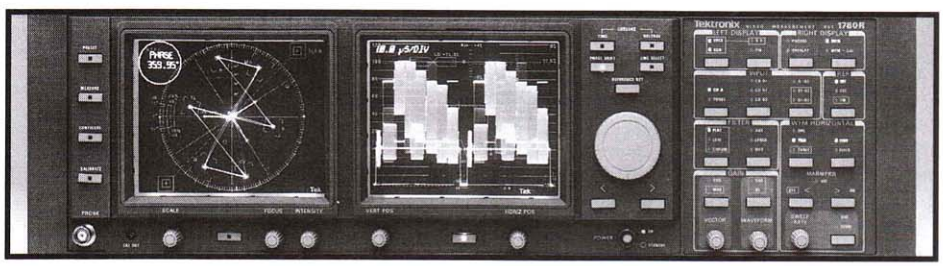
VMT
VM 700A Remote Control Software

- Controls the VM 700 or VM 700A
- Pull down and pop up menus simplify operation
- Conditional testing of incoming data
- PC based functions
- Text and graphics capture
- Adapts to VM 700A and its options

1780R/1781R
Video Measurement Sets

- Full bandwidth analog processing
- Precision waveform and vector measurements
- Polar SCH presentation with calibration mode
- Four loop-through video input channels
- Component or composite waveform evaluation
- Measurement-grade time and voltage cursors
- Precision differential phase/differential gain measurements even with noisy signals
- Stereo audio phase and amplitude display
- User definable semi-automatic setups
- Available for either NTSC or PAL standards

Betacam is a registered trademark of the Sony Corporation. SLIP is copyrighted by FTP Software, Inc.



ORDERING INFORMATION

VM 700A
Video Measurement Set **$16,500**
Opt. 01 – NTSC Measurements ..... **+$4,500**
Opt. 11 – PAL Measurements ..... **+$4,500**
Opt. 20 – Teletext Measurements ..... **+$3,000**
Opt. 21 – Camera Measurements ..... **+$6,500**
Opt. 30 – Component Measurements ..... **+$2,500**
Opt. 40 – Audio Measurements ..... **+$4,000**
Opt. 48 – GPIB Interface **$2,500**
Opt. 74 – White Phosphor CTR ..... **+$100**
Opt. 1C – Cabinet Version ..... **NC**
Opt. 1P – Printer Version (110 V only) ..... **+$625**
Opt. 1Z – Probe Adapter (067-1429-00) ..... **+$500**

VMBKUP
VM 700A Backup and Remote Control Software **$250**

VMREMGR
VM 700A Remote Graphics Software **$250**

VMT
VM 700A Remote Control Software **$195**

1780R/1781R
Video Measurement Sets **$9,900**

1780F02
Portable Carrying Case for 1780R/1781R **$275**

1780F05
Rack Mount Shelf **$95**

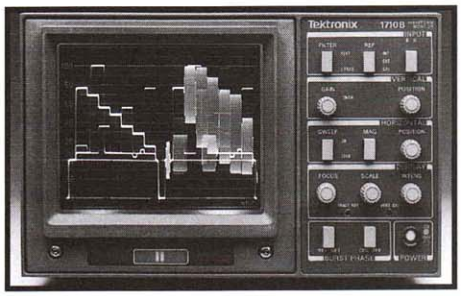
For complete product and ordering information, request a TV products catalog by completing the business reply card in the back.

Television Products

Waveform Monitors/Vectorscopes

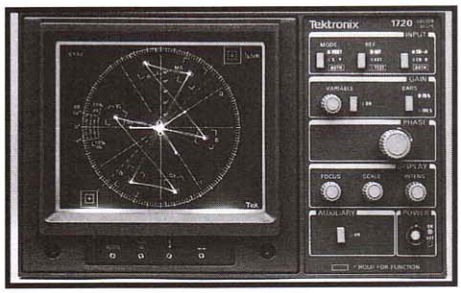
Waveform Monitors and Vectorscopes for Composite, Component, Serial Digital, Dual Standard, Multiformat.

- 1710B/1711B
- 1720/1721/1725
- 1720 SCH/1721 SCH
- 1730/1731/1735
- 1730 D/1731 D
- 1735 HD
- 1740A
- 1750A
- 1760
- WFM 300A



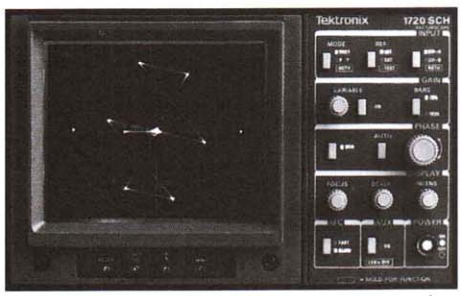
1710B/1711B
Waveform Monitors

- Easy operation/cost effective
- Burst phase indicator
- Dual filter display
- Bright CRT display
- Available in NTSC or PAL standards



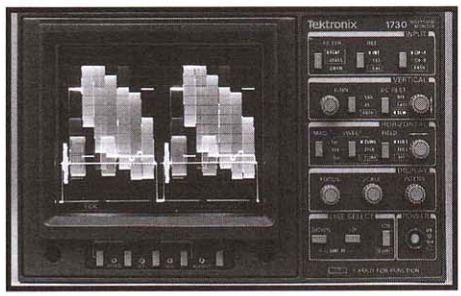
1720/1721/1725
Vectorscopes

- Performance and economy
- Simultaneous channel A & B display
- Stereo audio phase measurement
- R-Y output for differential phase measurement
- Available in NTSC, PAL or dual standard



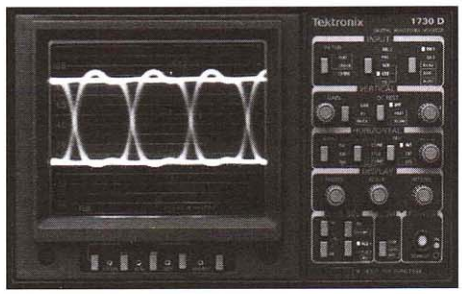
1720 SCH/1721 SCH
Vectorscopes with Polar SCH Phase Display

- Polar display of relative and absolute SCH phase
- Full line select capabilities when used with 1730 Series Waveform Monitors
- White CRT phosphor available for neutral color display applications
- Stereo audio phase and amplitude display
- Especially useful in editing suites for matched frame editing
- Digital phase shifter
- Available in NTSC (1720 SCH) and PAL (1721 SCH) standards



1730/1731/1735
Waveform Monitors

- Performance and economy
- Complete line select
- Simultaneous channel A & B display
- Differential gain measurement
- One button front panel recall
- Dual filter display
- VTR servo rates
- Available in NTSC, PAL or dual standard



1730 D/1731 D
Serial Digital Waveform Monitors

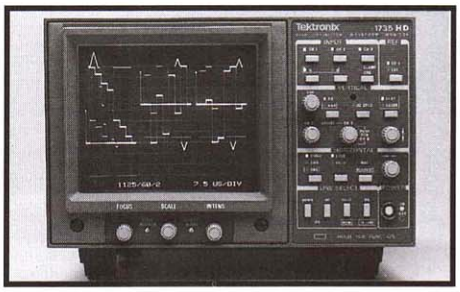
- Two analog composite inputs
- Two serial digital composite inputs
- One parallel digital composite input
- Passive loop-through for serial inputs
- Precision analog display of digital input
- Full time DAC output
- Serial digital bit stream EYE Pattern display
- Error Detection and Handling display mode (EDH)
- Displays D-2 servo waveforms
- Available in NTSC (1730 D) and PAL (1731 D) versions

Television Products

Waveform Monitors/Vectorscopes

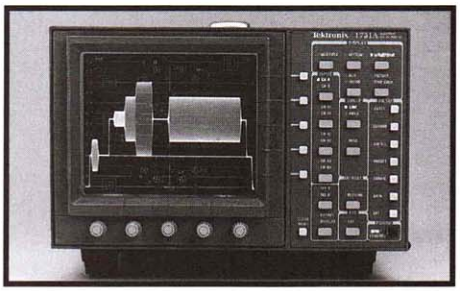
1735 HD
WFM 300A
1740A SERIES

1750A SERIES
1760 SERIES



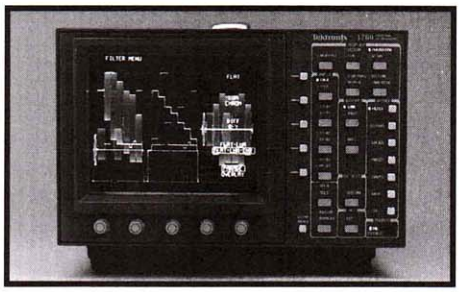
NEW 1735 HD
Multiformat Waveform Monitor

- Six video inputs
- 30 MHz video bandwidth
- Excellent performance in high magnifications
- High DC stability with front panel ground reference
- HDTV and standard video formats
- Full line select in each format
- Subtract mode for intersignal timing



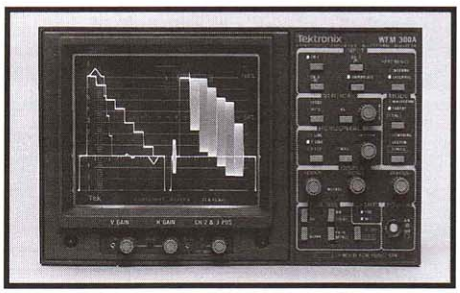
NEW 1740A/1750A SERIES
Analog Composite Waveform/Vector Monitors

- Easy to use operating system
- Eight video inputs
- Waveform and vector displays
- Picture display for signal identification
- Stereo audio phase/amplitude display
- Time code waveform display
- Waveform and vector cursors
- 1750A includes Polar SCH and color framing



NEW 1760 SERIES
Composite/Component Waveform/Vector Monitor

- Two composite plus two component inputs
- All composite features of the 1740A
- Component vector and Lightning displays
- Component picture monitor output
- Optional SCH and color framing



WFM 300A
Component/Composite Waveform Monitor

- Component and composite waveform display
- Lightning display for equipment setup and monitoring
- Bowtie display for system timing
- Menu selectable component format options
- Menu selected 625/50 or 525/60 configuration
- Separate GBR and composite picture monitor outputs
- Front panel user recalls for fast operation

ORDERING INFORMATION

1710B/1711B
Waveform/Burst Phase Monitor **$1,745**

1720/1721
Vectorscope **$2,250**

1725
PAL/NTSC Vectorscope **$3,200**

1720 SCH/1721 SCH
Vectorscope **$3,200**

1730/1731
Waveform Monitor **$2,250**

1735
PAL/NTSC Waveform Monitor **$2,490**

1730 D/1731 D
Serial Digital Waveform Monitor **$3,200**

1735 HD
HDTV Waveform Monitor **$5,900**

1740A (NTSC)/**1741A** (PAL)
Waveform/Vector Monitor **$4,200**

1745A
NTSC/PAL Waveform/Vector Monitor **$4,500**

1750A (NTSC)/**1751A** (PAL)
Waveform/Vector/SCH Monitor **$5,900**

1755A
NTSC/PAL Waveform/Vector/SCH Monitor **$6,200**

1760 (NTSC)/**1761** (PAL)
Composite/Component Waveform/Vector Monitor **$4,900**

1765
NTSC/PAL Composite/Component Waveform/
Vector Monitor **$5,200**

Opt. SC – (1760/1761/1765)
Adds SCH/Color Framing Display ..... **+$1700**

Opt. 74 – P4 White Phosphor.
Available on all half-rack 1700 Series products ..... **+$100**

WFM 300A
Component/Composite Monitor **$3,900**

Opt. 05 – Delete Color Shutter ..... **–$180**

Opt. 10 – NTSC/BETA CAM Transcoder ..... **NC**

Opt. 14 – NTSC/MII Transcoder ..... **NC**

ACCESSORIES

1700F00 – Plain Case **$60**

1700F02 – Portable Case **$95**

1700F05 – Dual Rack Adapter **$220**

1700F06 – Blank Panel **$60**

1700F07 – Utility Drawer **$150**

1700F10 – DC Voltage Kit **$220**

BP1
Battery Pack **$650**

AVC-20
Audio Vector Convertor **$495**

Serial Digital Video Interface

Generators, Inserters and D to A Converter

Parallel and Serial Digital

Digital Composite

Digital Component

DAC 422
TSG 170D
TSG 273
TSG 422

- New DAC 422
- Serial Digital Video Interface
- TSG 170D
- TSG 273
- TSG 422

Television Products
Generators/Inserters

NEW DAC 422 Precision Digital To Analog Converter
- Precision digital to component analog video conversion
- Supports 525/60 and 625/50 line rates
- Supports SMPTE/EBU N10 color difference, Betacam®, MII formats
- Accepts both parallel and serial digital inputs
- Provides reclocked serial digital output
- Compliments VM 700A Opt. 30 component measurements

SERIAL DIGITAL VIDEO INTERFACE FOR TSG 170D, TSG 273, AND TSG 422 GENERATORS
- Conforms to proposed standards for component, PAL, and NTSC composite serial digital video interfaces
- Includes error detection ancillary data
- Three BNC outputs each with its own driver

TSG 170D Digital Composite Generator
- NTSC Digital and analog test signal outputs
- Optional serial digital video outputs
- Digital and analog audio tone outputs
- RS-170A black burst output for master SPG application

TSG 273 PAL Composite Digital Signal Generator
- PAL test signals
- Analog and parallel digital test signal outputs
- Optional serial digital video outputs
- Serial and parallel digital audio outputs
- PAL sync generator with genlock
- Full field character identification
- Tape leader countdown

TSG 422 Digital Component Generator
- D1 VTR and other 4:2:2 component digital equipment testing and maintenance
- Conforms to CCIR recommendation 601, SMPTE 125M, and EBU Tech. 3246-E
- 10 or 8 bit signal generation
- Digital video test signal outputs
- Serial digital video output (Opt. 1S)
- Separate Y, B-Y, R-Y clock outputs
- 525/60 and 625/50 operation
- NTSC or PAL black burst outputs
- Sync lock to 525/60 or 625/50

ORDERING INFORMATION

DAC 422
Digital to Analog Converter **$3,900**

SERIAL DIGITAL VIDEO INTERFACE
Opt. 1S – Adds serial digital video outputs to the TSG 170D, TSG 273, and TSG 422 Generators **$500**

TSG 170D
NTSC Digital Composite Generator **$5,600**
Opt. 1V – VM 700A Signal Set ..... **NC**

TSG 273
PAL Composite Digital Signal Generator **$6,700**

TSG 422
Digital Component Generator **$5,500**

Television Products

Generators/Inserters

TSG 100	TSG 130A
TSG 111	TSG 131A
TSG 120	TSG 200
TSG 121	TSG 202

- TSG 100
- TSG 120/TSG 121
- TSG 130A/TSG 131A
- TSG 111
- TSG 200
- TSG 202

Generators

YC/NTSC

SVHS/PAL

Multiformat

TSG 100 NTSC Signal Generator
- Studio and transmission test signal sets
- 8 bit digital generation
- Conforms to RS-170A timing specifications
- 1 kHz audio tone
- H or V rate scope trigger signal
- DC power option
- Compact and lightweight

TSG 111 PAL Signal Generator
- Low cost test signal generator
- Tailored for service applications
- High accuracy (12 bit) signal generation
- Two channels of audio tone with channel one identification
- Compact and lightweight

TSG 120 YC/NTSC and TSG 121 SVHS/PAL Signal Generators
- Low cost test signal generator
- NTSC or PAL; Y,C and Y/C outputs
- Stereo audio outputs
- Ideal for equipment maintenance

NEW TSG 130A/TSG 131A Multiformat Generators
- Low cost test signal generator
- NTSC or PAL; Y,C; Y/C; Y, B-Y, R-Y; GBR and CTDM outputs
- Betacam® or MII levels
- Optional black burst output
- Stereo audio outputs
- Ideal for equipment maintenance

TSG 200 Signal Generator
- NTSC test signals
- Multiple black burst outputs
- Character identification positionable within the active field
- Tape leader countdown with visual and audio cues
- Stereo audio tone with channel one identification
- 12 volt DC input
- Remote control
- Applications:
  - Small production system SPG
  - Bars/ ID source for microwave links

NEW TSG 202 NTSC Signal Generator
- SMPTE bars
- Multiple black burst outputs
- 1 kHz audio tone
- 12 volt DC input
- Applications:
  - small production system SPG

ORDERING INFORMATION

TSG 100
NTSC Test Signal Generator **$1,250**

TSG 111
PAL Signal Generator **$1,500**

Opt. 10 – ±5 Hz internal reference ..... **+$100**

TSG 120
YC/NTSC Generator **$1,750**

TSG 121
SVHS/PAL Generator **$1,750**

TSG 130A
Multiformat Generator (NTSC) **$2,595**

TSG 131A
Multiformat Generator (PAL) **$2,595**

TSG 200
Signal Generator **$1,950**

TSG 202
NTSC Signal Generator **$1,250**

Television Products

Generators/Inserters

Generators and Inserters

NTSC

PAL

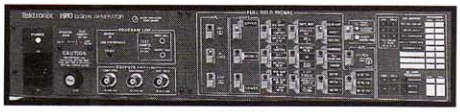
Digital Genlock

Audio Tone

- TSG 271
- TSG 170A
- 1910

TSG 271 PAL Television Generator
- Precise 12 bit digitally derived test signals
- SCH phase accuracy, guaranteed by use of a single DAC
- Conforms to EBU Statements D23 and D25
- Stable internal reference, ideal for master sync operation

TSG 170A NTSC Television Generator
- Simple, effective test signal complement
- Correctly SCH phased sync pulse generator with digital genlock
- Separate SMPTE bars with programmable D (Opt. 1)



1910 NTSC Digital Generator/Inserter
- Studio, transmitter, and transmission test signals
- 10 bit signal generation
- User friendly RS-232C control port for added versatility
- Four external VITS inputs
- Nonvolatile memory to maintain selected VITS and full field signal configuration after power interruption
- Ghost Canceller Reference (GCR) signal available

ORDERING INFORMATION

TSG 271
PAL Television Generator **$4,950**
Opt. 01 – Character ID and audio tone output ..... **+$635**
Opt. 05 – PAL-D Signals ..... **NC**

TSG 170A
NTSC Television Generator **$4,995**
Opt. 01 – Adds separate SMPTE bars output with 12 character ID, audio tone output and tape leader countdown.. **+$1,000**
Opt. 1V – VM 700A Signal Set ..... **NC**

1910
NTSC Digital Generator/Inserter **$7,500**
Opt. 01 – GCR signal and 0% setup test signals ..... **NC**
Opt. 02 – GCR signal and 7.5% setup test signals ..... **NC**
Opt. 03 – CBC test signals ..... **NC**
Opt. 04 – GCR signal and CBC test signal set (Opt. 03) ..... **NC**

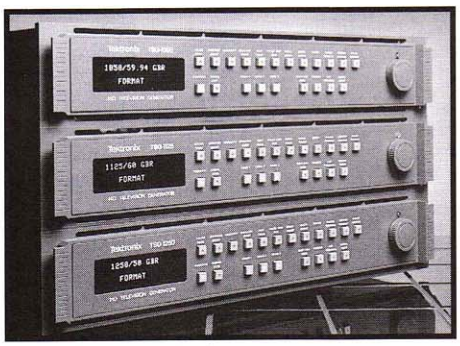
Television Products

Generators/Inserters

TSG 300	TSG 1000HD
TSG 370	SPG 1000
TSG 371	PE 1000

TSG 300 Component Television Generator
- Multiple formats and standards
  - Y, B-Y, R-Y (Y,P_b ,P_r ; SMPTE/EBU)
  - GBR, Betacam®, MII
  - 525/60 and 625/50
- 10 bit digital signal generation

TSG 370/TSG 371 Component/Composite Television Generators
- Analog component and composite test signals
- Simultaneous and independent component and composite test signal outputs
- High stability, correctly SCH phased internal sync generator



TSG 1000 HD Television Generator Family
- Supports proposed HDTV production standards
- Comprehensive test signal complement
- GBR and Y, P_B, P_R formats
- 30 MHz bandwidth
- 10 bit signal generation
- Analog and parallel digital test signal outputs
- Battery backup for signal memory
- Options: User PROM board, User RAM board, Picture monitor test pattern, Programmable zone plate generator

SPG 1000 HDTV Sync Generator
- Master sync generator for high definition television systems
- Synclocks to HDTV, NTSC, and PAL
- Supports proposed HDTV production standards
- Color bars and monitor setup test signals
- Provides genlock function for TSG 1000 Series Generators

NEW PE1000 PAL Encoder for TSG 1000 Series Generators
- High accuracy, wide bandwidth analog PAL test signals
- Y, U, V test signal library included
- Full programmability with the SDP 1000 Signal Development Package
- Adds the PAL color burst to luminance zone plate signals
- Compatible with the:
  - TSG 1001
  - TSG 1050 with a RAM board (Opt. 07)
  - TSG 1250 with a RAM board (Opt. 07)
  - TSG 1125 with a RAM board (Opt. 07) and a 72 MHz external clock signal
- Test signal, black burst, and color frame reference outputs

- TSG 300
- TSG 370/TSG 371
- TSG 1000 HD Family
- SPG 1000
- PE1000

Generators and Encoder

Component

Composite HDTV

GENERATORS/INSERTERS

ORDERING INFORMATION

TSG 300
Component Television Generator **$6,500**

TSG 370
Component/NTSC Television Generator (Betacam®/NTSC) **$4,800**
Opt. 01 – MII/NTSC ..... **NC**

TSG 371
Component/PAL Television Generator **$4,800**

TSG 1000 HD FAMILY
TSG 1050/TSG 1125/TSG 1250 HDTV Generator **$14,500**
Opt. 06 – PROM Board ..... **+$4,500**
Opt. 07 – RAM Board ..... **+$3,500**
Opt. 11 – HD Test Pattern ..... **+$4,500**
Opt. 12 – Y, P_b, P_r Test Pattern Board ..... **+$4,500**
Opt. 21 – Zone Plate Generator ..... **+$2,000**

PE1000
PAL Encoder **$4,500**

SPG 1000
HDTV Sync Generator **$5,000**
TVG F10 – Single Half-Rack Mount (for TSG 100 only) **$100**
TVGF11A – Single Rack Mount Adapter **$75**
TVGF12 – Portable Case Mount (1700F02)(for TSG 100 only) **$85**
TVGF13 – Dual Rack Adapter **$125**
TVGF14 – Dual Half-Rack Adapter **$125**

Television Products

Generators/Inserters

Generators and Inserters

Programmable

Multiformat

Test Patterns

VITS

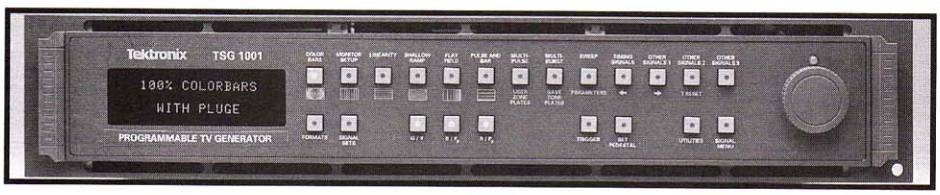
VIRS

GCR

NTC7

FCC

- TSG 1001
- TPG-625
- VITS 100
- VITS 200
- VITS 201



TSG 1001 Programmable TV Generator
- Multiformat, programmable test signal generator
- Programmable zone plate generator
- SDP 1000 Signal Development Package
- PC based software program
- Waveform editing and creation
- PC to generator test signal downloads
- SMPTE/EBU, Betacam®, MII, NTSC analog, NTSC composite digital, CCIR 601 component digital, and HDTV test signal libraries
- Internal or external clock operation
- 10 bit signal generation
- 30 MHz bandwidth
- Analog and parallel digital test signal outputs
- Battery backup for RAM signal memory
- Programmable trigger function for waveform analysis

TPG-625 PAL Pattern Generator
- PAL television test pattern
- Color monitor and receiver testing
- Programmable character identification
- 10 bit digital generation
- Digital genlock
- Black burst outputs
- Special pattern for VM700A Video Measurement Set (Opt. 01)

VITS 100 NTSC Generator/Inserter
- Low price generator/inserter
- NTC7, FCC, and VIR signals
- VM 700A recognizable vertical interval source identification

VITS 200 NTSC Generator/Inserter
- Full capability generator/inserter for use at the facility output point
- NTC7, FCC, VIRS, and GCR signals
- Four external VITS inputs
- VM 700A compatible vertical interval source identification
- Text generator for full field and vertical interval messages
- Sync and burst regeneration
- Full field test signal output
- RS-232C and ground closure remote control
- Loss of program continuity mode (standby mode)

VITS 201 PAL Insertion Generator
- CCIR, EBU, UK National ITS
- Operates in the presence of sound in syncs
- Four external ITS inputs
- Comp Sync output
- Source identification
- All user program settings saved in non-volatile storage
- User programs for:
  - Insertion of internal, external, and source identification signals
  - Loss of program input modes
  - Text insertion

ORDERING INFORMATION

TSG 1001
Programmable TV Generator **$18,000**

TPG 625
Pattern Generator **$5,500**
Opt. 01 – PAL Pattern Generator for use with VM 700A ..... **NC**

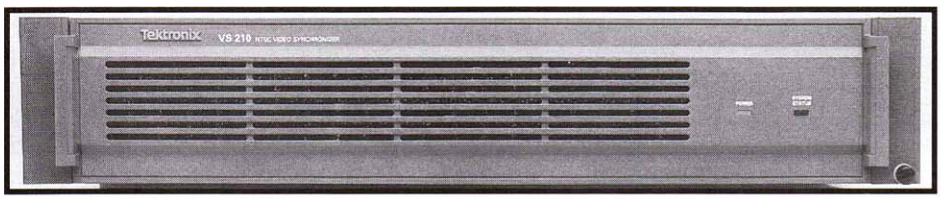
VITS 100
NTSC Generator/Inserter **$2,250**

VITS 200
NTSC Generator/Inserter **$4,500**

VITS 201
PAL Insertion Generator **$4,000**

Television Products
Synchronizers

VS 210 **VS 211** **110-S** **118-AS**



- VS 210
- VS 211
- 110-S
- 118-AS

Video and Audio Synchronizers

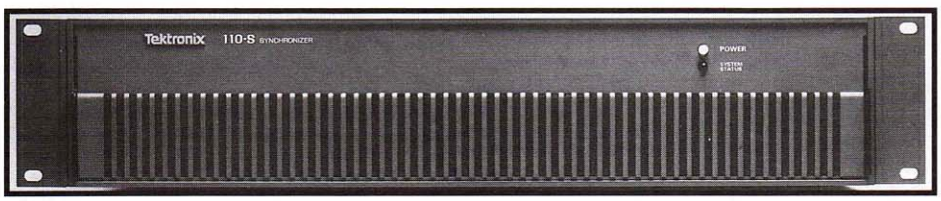
10-bit Accuracy

NTSC

PAL

VS 210 NTSC Video Synchronizer
- 10 bit digitizing
- 8 F_{sc} sampling
- 4 field memory
- Sync and burst insertion
- Digital processing amplifier functions
- Serial digital I/O
- Audio delay control signal output
- Remote control

VS 211 PAL Video Synchronizer
- 10 bit digitizing
- 8 field memory
- Sync and burst insertion
- Processing amplifier functions
- Composite digital input and output
- Audio delay control signal output
- Remote control



110-S Video Synchronizer
- True 10 bit accuracy and resolution
- Tracks signals into the noise
- Optional four-field memory for the highest picture quality
- Digitally precise RS-170A sync and burst insertion
- Heterodyne color processing
- Auto VTR signal recognition
- Infinite window correction range

118-AS Audio Synchronizer
- Automatic or manual control of audio to video timing
- Simple one-wire interface to 110-S, VS 210, or VS 211 Video Synchronizers
- Expandable to 3 channels for stereo and auxiliary channel
- Compensates for 30+ fields of video delay

ORDERING INFORMATION

VS 210
NTSC Video Synchronizer **$7,995**

RC 210
Remote Control for VS 210 ..... **$1,000**

VS 211
PAL Video Synchronizer **$7,500**

RC211
Remote Control for VS 211 ..... **$1,000**

110-S
Video Synchronizer **$13,750**

Opt. 20 – Adds Time Base Correction for Heterodyne Color VTRs ..... **+$1,200**

118-AS
Audio Synchronizer **$5,500**

Television Products
Audio Products

Audio Products

BTSC

NICAM

Nordic

DIN

NICAM Processing

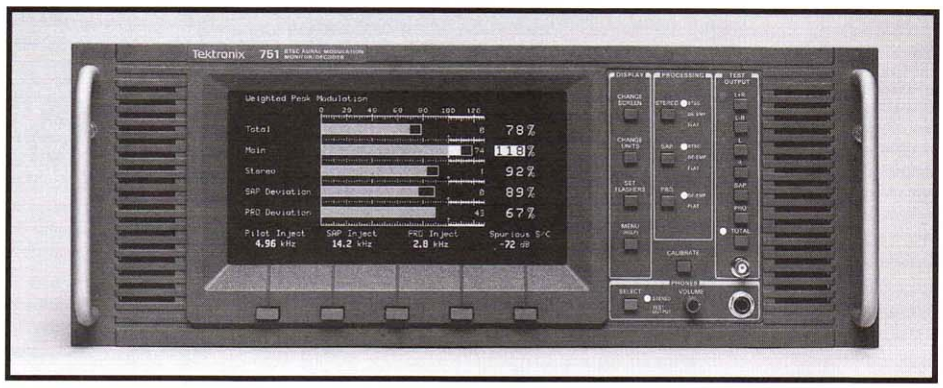
Complete Audio Phase & Level Monitoring

Adds Audio Monitoring to a Vectorscope

Multitone Testing

RS 232 Remote Control

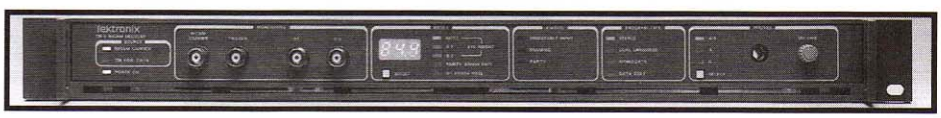
- 751
- PC 751
- 728D
- 728E
- AVC-20
- 760A
- 760N
- 760D
- ASG 100



751 BTSC Monitor
- Precision modulation monitor for entire BTSC sound channel
- Simultaneously displays all components necessary to ensure modulation remains within legal limits
- Bars feature peak indicators with timed peak hold and easily set peak limits
- 4.5 MHz demodulator input available

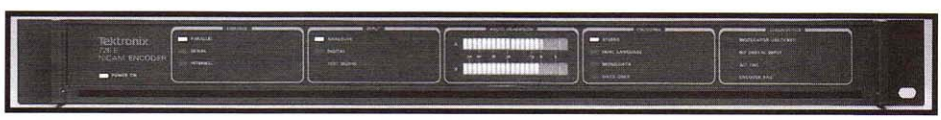
The 751 BTSC aural modulation monitor/decoder provides accurate modulation monitoring and measurement of the BTSC encoded TV sound channel.

PC 751 Remote Display Software
- Remote display of 751 Screens over RS-232 on a PC
- Real-time display of peak modulation and processed audio screens
- Data logging of the held peak data



728D NICAM Decoder
- Numeric Eye Height/Parity Display
- Monitoring Outputs
- Digital Bitstream Connection

The Tektronix 728D NICAM Decoder demodulates the NICAM-728 carrier and decodes the left and right analog audio channels and a monaural channel derived from them as well as providing access to the user data bits and 728 kB/s data stream. It also monitors the performance of the digital bitstream and provides indications for service type, loss of carrier, and errors.



728E NICAM Encoder
- Multi Systems (I and B/G)
- Analog Audio Inputs
- Digital Data Input
- Digital Data Outputs
- I.F. Mixer/Combiner Option
- Built-In Test Signals

The Tektronix 728E NICAM Encoder has been designed as a cost-effective solution to a broadcaster's requirements for NICAM-728 encoding and modulation.

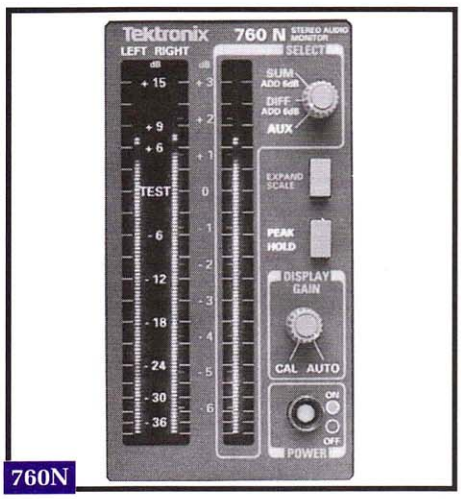
AVC-20 Audio Vector Converter
- Use with any NTSC Vectorscope
- Balanced Line Level Inputs
- User Selectable Display Formats; Lissajous Pattern with Calibrated Amplitude; Lissajous Pattern and Sweep Displays of Both Channels
- Time Code or Third Channel Input; Field Locked for Time Code Phase

The AVC-20 provides stereo audio monitoring capability when installed with an NTSC Vectorscope. Complete audio monitoring can be added to VTR bridges, master control consoles and other locations requiring stereo audio monitoring without modifying the vectorscope and without using front panel space.

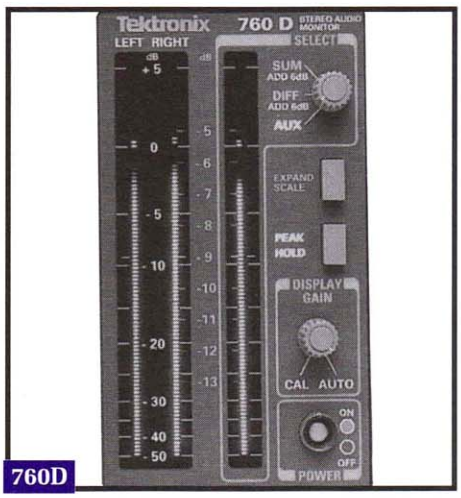
Television Products

Audio Products

760A	760D
760N	ASG 100

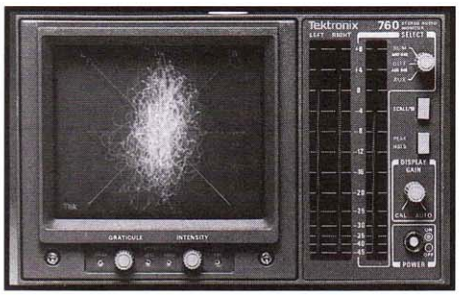


760N



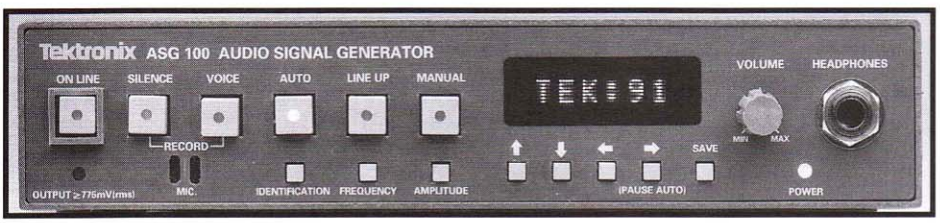
760D

With Tektronix' 760 Series Stereo Audio Monitors, the audio engineer can analyze a pattern display of the stereo audio signal. This display, along with a high resolution bar graph, provides accurate monitoring and measurement capabilities. Used in both operation and setup, the instrument provides immediate feedback of the audio signal for creative or technical correction. With the appropriate test signals, the unit can also be used for accurate phase and amplitude measurements. Three product versions are available with various scales: 760A (standard), 760N (Nordic), or 760D (DIN) (see photos).



760 SERIES Stereo Audio Monitor

- Graphic CRT display of stereo audio signal
- AGC for continuously viewable pattern
- Bar graph for quick setups and accurate peak indication
- Third bar indicates mono compatibility when set to L+R
- Suitable for phase and amplitude measurements
- Optional Nordic or DIN Scale
- Scale and dynamics conform to proposed IEEE ppm standard
- EXPAND SCALE feature increases resolution at –8 dB (760A) level for accurate line-ups
- White phosphor CRT option available



ASG 100

- Dual channel for stereo applications
- Balanced inputs and outputs
- Connects in-line for easy test signal insertion
- Quick identification of insertion point with voice ID
- Short duration audio test sequence for rapid automatic checkout of audio lines
- Single button selection of line-up tone
- Manual mode allows selection of frequency and amplitude

ORDERING INFORMATION

751
BTSC Aural Modulation Monitor/Decoder **$12,000**
Opt.01 – 4.5 MHz Demodulator Board **$2,000**

728D
NICAM Decoder **$3,200**
Opt. 01 – System I (6.552 MHz) ..... **NC**
Opt. 02 – System B/G (5.85 MHz) ..... **NC**

728E
NICAM Encoder **$8,000**
Opt. 01 – Delete modulator ..... **–$2,500**
Opt. 03 – Mixer/combiner board ..... **+$1,200**

AVC-20
Audio Vector Converter **$495**

760A
Stereo Audio Monitor **$2,500**

760D
Stereo Audio Monitor **$2,500**

760N
Stereo Audio Monitor **$2,500**
Opt. 74 – White Phosphor CRT (760 Series) ..... **+$100**

ASG 100
Audio Signal Generator **$1,800**

For complete product and ordering information, request a TV products catalog by completing the business reply card in the back.

1705A	2714
1450	2721
TDC	2722
TDC-10	

Television Products

RF Products

RF Products

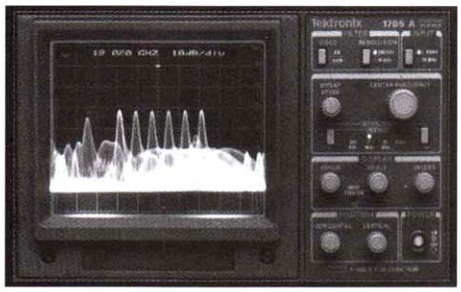
Low Cost Spectrum Display of Satellite Signals

Measurement Quality Television Demodulator

Automatic Cable TV RF Measurements

Non-Interfering Cable TV System Sweep

- 1705A
- 1450
- TDC
- TDC-10
- 2714
- 2721
- 2722



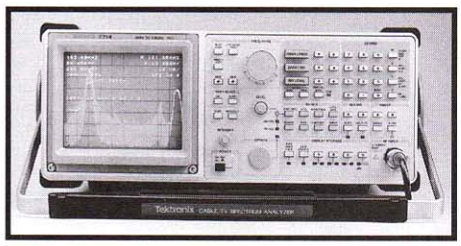
1705 A Spectrum Monitor
- Full 850 MHz span for international satellites
- L-Band and 70 MHz IF inputs
- Designed for satellite news gathering
- On-screen Ku- or C-Band frequency readout
- Selectable 2 dB/div or 10 dB/div sensitivity
- Resolution bandwidth switchable to 10 kHz or 300 kHz
- Span range and video filter selection
- Portable DC power and battery available

1450 Series Demodulators
- Measurement-quality performance resulting in negligible distortion
- Precise Nyquist slope provided by surface acoustic wave filter
- Wide dynamic range with constant bandpass characteristics
- Synchronous detection eliminates quadrature distortion
- Envelope detection for determining differential phase

1450-1 Only
- Wideband audio output for BTSC multi-channel sound applications
- Wideband audio output compatible with Japanese stereo sound with FAX channel

1450-2/1450-3A Only
- NICAM intercarrier output compatible with 728D NICAM Decoder input

TDC-10 Tunable Down Converter
- Covers all Cable TV, VHF, and UHF channels up to 1 GHz
- Built in frequency counter for visual carrier frequency and aural carrier offset
- GPIB or RS232 remote control
- User programmable channel tables



2714 Cable TV Spectrum Analyzer
- Automatic positioning of visual aural carriers
- Visual and aural carrier levels and frequencies for selected channels
- Survey of system visual and aural carrier levels and frequencies
- Depth of modulation
- Aural carrier deviation measurement
- Visual carrier-to-noise measurement
- Visual to carrier amplitude and frequency difference measurements

2721/2722 Non-Interfering Cable TV System Sweep
- Non-interfering
- Full 5-600 MHz range
- Full Alpha Keyboard for data entry
- LCD Display visible even in bright sunlight
- Lightweight, compact Receiver
- Frequency-agile Telemetry
- 50-waveform NVRAM storage
- RS-232C downloads stored waveforms to Serial Printer or PC
- PC download software included

ORDERING INFORMATION

1705 A
Spectrum Monitor **$3,850**

1450-1
Demodulator (System M) **$14,900**
Opt. 01 – 37 MHz Vision IF ..... **+$500**
Opt. 02 – 38.9 MHz Vision IF ..... **+$500**
Opt. 03 – 45.75 MHz Vision IF ..... **NC**

1450-2
Demodulator (System B/G) **$15,500**
Opt. NI – NICAM ..... **+$2,500**

1450-3A
Demodulator (System I) **$15,500**

TDC
Fixed Channel Down Converter (Specify Channel) **$4,950**
Opt. 01 – 37 MHz Vision IF ..... **NC**
Opt. 02 – 38.9 MHz Vision IF ..... **NC**
Opt. 03 – 45.75 MHz Vision IF ..... **NC**
Opt. 11 – System M except Japan and Okinawa ..... **NC**
Opt. 12 – System B/G/I countries ..... **NC**
Opt. 14 – Japan and Okinawa ..... **NC**

TDC-10
Tunable Down Converter **$9,900**

2714
Cable TV Spectrum Analyzer **$14,200**

2721
Sweep Transmitter **$6,900**

2722
Sweep Receiver **$7,900**
Opt. 01 – Chart Recorder ..... **+$950**

Computer Graphics

CONTENTS

COMPUTER GRAPHICS
Color Printers 506
Terminals.....508
Display Monitors.....510

Computer Graphics Group

The Computer Graphics Groups operate in three areas of the computer peripherals industry – Color Printers, Graphics Terminals, and Advanced Displays.

COLOR PRINTERS

Many electronic measurements – waveforms, digital events, etc. eventually find their way into some kind of document or graphic record. Tektronix' color printers are perfectly matched to the task of printing such records, as well as everything from postcards to T-shirt transfers in vivid color.

GRAPHICS TERMINALS

Tektronix offers traditional graphics terminals and most recently, X terminals – devices that provide windowed access to multiple hosts and applications across a network.

ADVANCED DISPLAYS

The Display Products Operation markets advanced technologies, including large, flat-panel displays; ultra-high resolution monitors; stereoscopic 3-D displays; and color shutter displays, which offer higher color definition than do conventional devices.

IISD
II PXe/PXi
III PXi

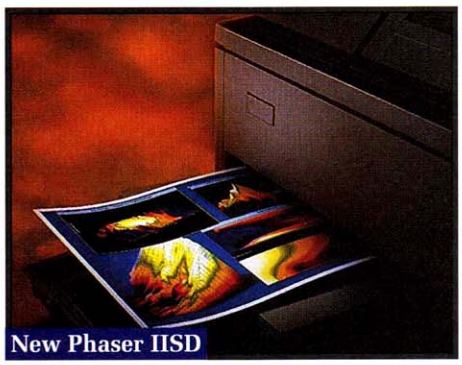
4511A
469LAM
4693FXI

Phaser™ Color Printers

Tektronix Brings Brilliant Color and PostScript Level 2 printing to Engineering, Scientific, and Graphic Arts plus a host of Specialized Applications.

PHASER SERIES

- Brilliant, Accurate Color
- Powerful, Fast RISC Processor
- –24 MHz (IISD, II PXi, III PXi)
- –17 MHz (II PXe)
- PostScript Level 2 Software
- 39 Resident Fonts (IISD, II PXi, III PXi)
- 17 Resident Fonts Expandable to 39 (II PXe)
- TekColor PS Color Fidelity, Software,
- Pantone Approved
- Easy Operation
- Room to Grow
- Worry Free Service
- Worldwide Support


New Phaser IISD

Phaser III PXi

Phaser II SD

- Fast photographic printing
- Process complex images
- Photographic quality transparencies
- Smooth shading

Phaser II PXe/PXi

- Supports multiple systems
- Powerful networking
- Precise color control and registration

Phaser III PXi

- Exceptional color durability on prints
- Media Flexibility
  - –Prints on letterhead, forms, tracing paper, card stock
  - –Size from 4 x 6 in. (102 x 153 mm) post cards to full bleeds on 12 x 18 in. (305 x 457mm)
- Precise registration
- Powerful networking
- Serves multiple hosts simultaneously

New Media Laminator

Phaser Media Laminator

By laminating Phaser III transparencies, you can produce dazzling, durable presentations with vibrant colors. Lamination gives your Phaser III presentations more fully-saturated colors and sharper edges.

DURABLE FINISH STANDS UP TO HEAVY USE
Lamination provides a durable finish for transparencies and many types of paper. It protects your frequently-used prints against dirt, scratches, and wrinkles. Laminated prints are easily three-hole punched for storage in a three-ring binder.

APPLICATION REFERENCE

Phaser IISD	Phaser II PXe/PXi	Phaser III PXi
• Photo realistic printing • Highest quality paper and overhead transparencies, often containing scanned artwork • EtherTalk interface (optional)	• Workgroup production printing • Large numbers of overhead transparencies • HP-GL support • Low cost proofs for Phaser IISD	• Workgroup color printing on plain paper • Flexible paper size and type requirement • HP-GL support

ORDERING INFORMATION

PHASER IISD
Color Printer. Order 4684 ..... *1
Includes: Input Tray (adjustable for US letter/legal size media); Universal Output Tray; US Power Cord; AMD 29000 RISC-based Image Controller w/16 Mbytes RAM; Media Startup Kit with paper/transfer roll, transfer roll tray, installation poster, user manual, cleaning kit, utilities, drivers, sample images on diskettes in MAC and PC formats.

Opt. 01 – Metric Media Kit and Input Tray (replaces US media and tray) *1

Opt. 02 – Internal EtherTalk Interface Hardware (provides EtherTalk connectivity) *1

Opt. 04 – 4 Mbyte Upgrade (total 20 Mbytes) *1

Opt. 32 – 32 Mbyte Upgrade (total 48 Mbytes) *1

F-KITS AND ACCESSORIES

16 Mbytes RAM – Add one kit for a total of 32 Mbytes; add two kits for a total of 48 Mbytes. Order 4680F16 ..... **$1,995**

4 Mbyte RAM Upgrade – Order 4690F4M **$595**

EtherTalk Interface Hardware – Provides EtherTalk connectivity. Order 4684F02 ..... *1

Ethernet TCP/IP Interface – Order 4511A **$1,495**

[1]Contact your local Tektronix representative for price information.

To order, contact your local sales office (listed on the inside back cover).

Phaser Color Printers

IISD	4511A
II PXe/PXi	469LAM
III PXi	4693FXI

ORDERING INFORMATION

PHASER II PXe
Color Printer *1
Includes: US letter-size Input Tray (adjustable for letter and legal paper sizes); Universal Output Tray; US Power Cord; 29000 RISC-based Image Controller with 4 MB RAM; Media Startup Kit with paper and transparency film, 3-color transfer roll (startup print quantity), transfer roll tray, installation guide, user manual, cleaning kit, utilities, drivers.

PHASER II PXi
Color Printer *1
Includes: US letter-size Input Tray (adjustable for letter and legal paper sizes); Universal Output Tray; US Power Cord; 2900 RISC-based Image Controller with 6 MB RAM; Media Startup Kit with paper and transparency film, 3-color transfer roll (startup print quantity), transfer roll tray, installation guide, user manual, cleaning kit, utilities, drivers and sample images for Apple Macintosh, IBM PC/AT, PS/2 and compatibles.

Opt. 01 – Metric-size Media Kit and Input Tray (replaces US media and tray) *1
Opt. 04 – Add 4 Mb memory *1
Opt. 08 – (Phaser II PXi only) Add 8 Mbyte memory *1
Opt. 1F – (Phaser II PXe only) Additional 22 fonts *1
Opt. L1 – French user manual *1
Opt. L2 – Italian user manual *1
Opt. L3 – German user manual *1
Opt. L4 – Spanish user manual *1

ACCESSORIES
Printer Cart – Two shelves for transfer roll and media storage. Order 469CART **$395**
Extra US letter/legal-size Paper Tray – Order 436-0204-01 ..... **$99**
Extra Metric A4/A4 special-size Paper Tray – Order 436-0205-01 ..... **$99**
4 MB SIMM – Adding memory with or after initial purchase. Order 4690F4M **$99**
Font Upgrade – (Phaser II PXe only) 22 additional fonts. Order 4694F1F **$595**

PHASER III PXi
Color Printer. Order 4698PXi **$9,995**
Includes: Letter-size Input Tray (adjustable for US and Metric paper sizes); 2 Color Sticks each of black, cyan, magenta, and yellow; Universal Output Tray; US Power Cord; AMD 29000 RISC-based Image Controller with 10 Mbyte RAM; Media Sampler Kit with bond paper, cover stock, and transparency film; English User Manual.

Opt. 01 – Add universal input tray and ink startup kit (8 sticks each of black, cyan, magenta, and yellow) ..... **+$395**
Opt. 04 – Add 4 Mbyte memory (total of 14 Mbyte); this option is required to print a full image area on 12 x 18 in. (305 mm x 457 mm) media ..... **+$595**
Opt. 08 – Add 8 Mbyte memory (total of 18 Mbyte); this configuration provides sufficient memory for many downloaded fonts, very complex images, and additional input buffer for enhanced throughput *1
Opt. L1 – French User Manual substitution *1
Opt. L2 – Italian User Manual substitution *1
Opt. L3 – German User Manual substitution *1
Opt. L4 – Spanish User Manual substitution *1

ACCESSORIES
Phaser III Printer Cart – With drawer and multi-position shelf for ink and media storage. Order 4698CRT **$695**
Letter-size Input Tray – For A or A4-size media. Order 436-0224-00 ..... **$125**
Universal Input Tray – For A, A4, B, A3-size media. Order 436-0222-008 ..... **$150**
4 Mbyte SIMM – For adding memory to the printer after initial purchase. Order 4690F4M **$595**
PhaserPrint Screencopy Software – For SUN4 workstations. Order 4690F22 ..... **$995**
Screen Copy Software – For HP workstations. Order 4690F43 Opt. 12 ..... **$995**
Phaser Media Laminator – Optically improves transparencies for projection. Adds durability to both transparency and paper prints. The laminated prints are writable and erasable. Order 469LAM **$175**
Network Interface – Adapter to connect the printer into TCP/IP or DECnet Ethernet environments. Order 4511A **$1,495**
Phaser III PXiJ Configuration – Includes all the same configurations and options as a Phaser III PXi plus Kanji fonts on a 100 Mbyte external hard disk drive. Order 4698PXS **$12,990**

4693FXi
Upgrade Kit.
Order one or a combination of the upgrades for your 4693 printer: 4693D, 4693 DX, 4693 RGB, RGB II, Phaser CP, Phaser CPS, Phaser PE, or Phaser PX.
4693FXi – Upgrades to PostScript Level 2 compatibility **$2,495**
4693FPX – Upgrades to PostScript Level 1 compatibility **$995**
4690F4M – Add 4 Mbytes memory with or after initial purchase **$595**

469LAM
Phaser Media Laminator **$995**
Includes: Laminator US power cord, Output Tray, User Manual.
Opt. 01 – Each kit contains 100 lamination sheets and 100 lamination folders: 016-1163-00: A size media kit (8.5 x 11 in.) 016-1164-00: A4 size media kit (210 x 297 mm) *1

INTERNATIONAL POWER PLUG OPTIONS
Opt. A4 – North American 240 V, 60 Hz ..... **NC**
Opt. A5 – Switzerland 220 V, 50 Hz ..... **NC**
See General Customer Information Section for additional description.

4511A
Network Interface **$1,495**
Includes: One year of depot service, power supply, PC parallel port-to-printer cable, 61 meters (2 ft.) 50 Ω BNC F-M-F "T" connector, 50 Ω BNC terminator, self-adhesive mounting tape, 4511A Network Interface User Manual.
Opt. 01 – Configuration Kit: includes all the cables needed to attach any type of terminal to the 4511A for configuration ..... **+$80**

ADDITIONAL ACCESSORIES
Field Installation Kit – PhaserSym Software: VMS print symbiont. Order 4690F41 ..... **$495**

INTERNATIONAL POWER PLUG OPTIONS
Opt. A1 – Universal Euro 220 V, 50 Hz ..... **NC**
Opt. A2 – United Kingdom 240 V, 50 Hz ..... **NC**
Opt. A3 – Australian 240 V, 50 Hz ..... **NC**
Opt. A5 – Switzerland 220 V, 50 Hz ..... **NC**
See General Customer Information Section for additional description.

**1 Contact your local Tektronix representative for price information.*

To order, contact your local sales office (listed on the inside back cover).

XP300 SERIES XP10 SERIES Terminals

Broad Family of Affordable Price/ Performance Terminals.

XP330 SERIES

- RISC X Terminals
- Fully Compatible with SUN, DEC and other UNIX Compute Environments
- Displays with Workstation Resolution and Quality
- Server is Optimized for Maximum Performance with a Broad Range of Demanding Technical and Engineering Applications for Superior User Productivity
- Worldwide Sales, Service and Support

XP10 SERIES

- Dual Access Via Ethernet and Serial Connection
- Fully Compatible with Sun, DEC and other UNIX Compute Environments
- Ergonomically Designed with User-Friendly Features, like Flicker-Free Resolution, Small Footprint, and Optional IBM, DEC, or UNIX Keyboard
- Validated with Hundreds of UNIX Applications
- World Wide Sales, Service and Support

XP330 Series Family

XP330 Series

APPLICATIONS

The RISC-based TekXpress™ Series 330 terminals provide the best value in high-performance X terminals. With a complete range of functionality, compatibility with all major compute environments and premium-quality, workstation-class, displays, the XP330 Series meets a broad range of application needs.Whether you work in design automation, computer-aided software engineering ,process control, earth resources, or any other scientific, technical or engineering disciplines, there is a Series 330 X terminal just right for you.

The Series 330 employs a dual-processor RISC architecture that turbo-charges networking performance with a MIPS R3000 microprocessor and delegates graphics and windowing functions to a separate graphics processor. The result: blazingly fast graphics with high-throughput network communications. The superb resolution of both monochrome and color terminals enhances graphics and text and increases your productivity.

For heavy duty assignments that require optimum application performance, choose TekXpress Series 330 X terminals.

XP330 SELECTION GUIDE

	XP334	XP336	XP337	XP338
Display Size	19 in. tilt & swivel	17 in. tilt & swivel	19 in. tilt & swivel	19 in. tilt & swivel
Resolution	1280 x 1024	1152 x 900	1152 x 900	1280 x 1024
Display Type	gray-scale	color	color	color
Display Colors	256 shades of gray	256 colors	256 colors	256 colors
Color Palette		16.7 million	16.7 million	16.7 million
Refresh Rate	72 Hz	72 Hz	72 Hz	72 Hz
Display DPI/Dot Pitch	99	101/0.28	86/0.31	98/0.28

To order, contact your local sales office (listed on the inside back cover).

XP10 Series Family

XP10 Series

APPLICATIONS

The TekXpress™ Series 10 terminals have been optimized to provide the best price-performance at the lowest possible cost while ensuring compatibility with all major computer environments. From our lowest-cost monochrome to our most spectacular large-screen color model, TekXpress Series 10 terminals give you excellent display resolution and clarity, access to wide range of applications on a variety of hosts, and comprehensive support of industry-standard network protocols. All for less than you'd pay for comparable PC or diskless node alternatives.

XP10 Series terminals are a good fit for on-line transaction processing, computer-aided software engineering, electronic publishing, or any of a number of other networking applications requiring fast interactivity and high-resolution graphics and text. TekXpress X terminals are also more economical because they take advantage of computing power, security and storage resources of the network – something other options can't.

XP10 SELECTION GUIDE

	XP11	XP12	XP13	XP17	XP18
Display Size	15 in. tilt & swivel	19 in. tilt & swivel	15 in. tilt & swivel	14 in. tilt & swivel	17 in. tilt & swivel
Resolution	1024 x 786	1280 x 1024	1024 x 768	1024 x 768	1152 x 900
Display Type	monochrome	monochrome	gray-scale	color	color
Display Colors	b/w	b/w	16 shades of gray	256 colors	256 colors
Color Palette			256	16.7 million	16.7 million
Refresh Rate	70 Hz	72 Hz	70 Hz	70 Hz	72 Hz
Display DPI/Dot Pitch	100	100	100	100/.28	100/.28

Characteristics

XP330 SERIES
XP10 SERIES

Main CPU – MIPS R3000 @ 20 MHz.

Graphics Processor – TI 34020 @ 40 MHz.

SIMM Memory – 5 MB standard expandable to 42 MB.

Boot Options – X Server code downloadable from host or optionally from ROM card.

Boot Protocols – TFTP, MOP.

Host Ports – 10base 5 AUI (thicknet), 10base 2 (thinnet) or 10baseT (twisted pair).

Peripheral Ports – Two, 9 pin RS-232 connectors.

Network Protocols – Standard: TCP/IP, NFS, BOOTP, RARP, SLIP. Opt.: TDEnet (DECnet), including DAP, LAT and MOP.

Parameter Set-up – Motif-like set-up menu system.

Available Keyboards – IBM101, VT220; Opt.: UNIX (SUN-compatible) keyboard.

Printer Support – Network printer support.

Input Options – Tablet, touchscreen, barcode reader support, trackball.

Server – X server based on X11 Release 4.

ORDERING INFORMATION

All XP terminals include:
Logic Unit, Display Monitor, Ethernet Interface, 3 Button Mouse, Keyboard, Power Cord, and User Manual.

XP11
15 in. Monochrome Terminal **$995**

XP12
19 in. Monochrome Terminal **$2,495**

XP13
15 in. Gray-Scale Terminal **$1,695**

XP17
14 in. Color Terminal **$1,995**

XP18
17 in. Color Terminal **$3,795**

Opt. 10 – ROM X-Server Boot and Fonts ..... **+$400**
Opt. 22 – Add 2 MB Memory ..... **+$350**
Opt. 24 – Add 4 MB Memory ..... **+$600**
Opt. 3J – 10BASE2 Thin Thinnet LAN ..... **NC**
Opt. 3K – 10BASE5 Thick Thicknet LAN ..... **NC**
Opt. 3M – 10ASE-T TW PR Twisted Pair LAN XP11, XP12, XP13, XP17, XP18 ..... **NC**
Opt. 3N – TDENET DECMET Protocol ..... **+$250**
Opt. 31 – Delete Keyboard ..... **–$150**
Opt. 49 – Rental ID ..... **NC**

XP334
19 in. Gray-Scale Terminal **$3,495**

XP336
17 in. Color Terminal **$4,750**

XP337
19 in. Color Terminal **$4,995**

XP338
19 in. Color Terminal **$5,995**

Opt. LP – Low Profile Logic Module ..... **+$400**
Opt. 10 – ROM X-Server Boot and Fonts ..... **+$400**
Opt. 22 – Add 2 MB Memory ..... **+$350**
Opt. 24 – Add 4 MB Memory ..... **+$600**
Opt. 25 – Add 8 MB Memory ..... **+$1,200**
Opt. 3A – 10BASE5/10BASE2 Thick/Thin NET ..... **NC**
Opt. 3B – 10ASE/10BASE5 Twisted Pair/Thicknet LAN ..... **NC**
Opt. 3L – Motif Window MA Local Client ..... **+$60**
Opt. 3N – TDENET DECMET Protocol ..... **+$250**
Opt. 49 – Rental ID ..... **NC**
Opt. RM – Rackmount (XP337, XP338 only) ..... **+$1,100**

INTERNATIONAL POWER PLUG OPTIONS
Opt. A1 – Universal Euro 220 V, 50 Hz ..... **NC**
Opt. A2 – United Kingdom 240 V, 50 Hz ..... **NC**
Opt. A3 – Australian 240 V, 50 Hz ..... **NC**
Opt. A5 – Switzerland 220 V, 50 Hz ..... **NC**

WARRANTY
One year return to depot or 90 day onsite.

To order, contact your local sales office (listed on the inside back cover).

Display Monitors

All 600 Series products are available in open frame configuration or with the optional cabinet. The products incorporate a Tektronix manufactured CRT and are backed up by the Tektronix World-Wide Sales and Service Organization.

606B

- Very High Resolution
- Uniform Brightness
- Multi-Imaging Capability
- Ultra Sharp Images
- Image Stability
- High Reliability

APPLICATIONS

- Gamma Camera Recording
- Other Photographic Recording
- Scan-Conversion Imaging
- Scanning Electron Microscopy

608

- High Brightness
- High Resolution
- Excellent Gray Scale
- Optimum Viewing Capability
- High Ambient Viewing
- Photographic Quality Images

APPLICATIONS

- Ultrasound Imaging
- Spectrum Analysis
- IR Imaging
- Mass Spectroscopy
- Test and Measurement

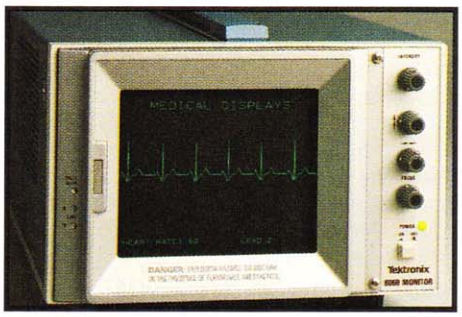
620

- Mechanically Rugged
- Versatile Modular Packaging
- Low Power Consumption
- Economical Display
- High Reliability

APPLICATIONS

- Ultrasound Analysis
- Electronic Equipment Testing
- Network Analysis
- Non-Destructive Testing

To order, contact your local sales office (listed on the inside back cover).



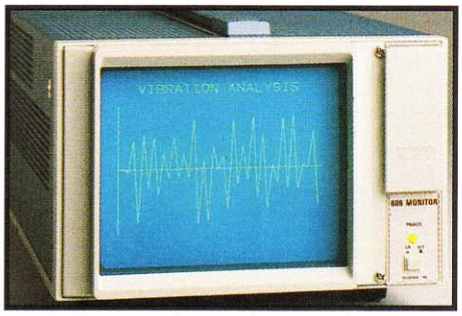
606B Option 06

Very High Resolution

The 606B Very High Resolution X-Y Display is ideal for photographic recording applications in medical gamma camera systems, where image stability, gray scale performance and uniform brightness are critical. It is also superior in applications such as electron microscopy or radiation and thermal imaging.

TEKTRONIX-HEWLETT PACKARD CROSS REFERENCE

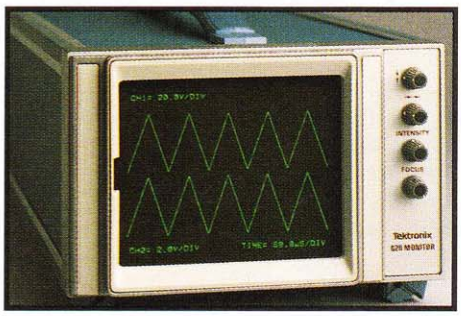
	606B	608	620
HP 1208A			X
HP 1208B			X
HP 1304A	X		
HP 1332A		X	
HP 1333A	X		
HP 1336S	X		
HP 1340A			X
TEK 602			X
TEK 604		X	
TEK 624		X	



608 Option 23

High Brightness

The 608 High Brightness X-Y Display is designed for easy reading in high ambient light. Its sharp image is well-suited for medical and military imaging and electronic instrumentation. The high brightness (70 fL), 10-mil spot size and large screen (9.8 x 12.2 cm) allow high quality photography.



620 Option 23

Mechanically Rugged

The 620 General-Purpose X-Y Display is economical, yet reliable and mechanically rugged. It is an ideal display for signal analyzers, yet rugged enough for vibration tests and non-destructive testing (NDT). Its 15-mil spot size and useable brightness (up to 30 fL) are appropriate for A-mode imaging in medical instrumentation.

Display Monitors

600 SERIES

SELECTION GUIDE

Key Specifications	606B	608	620
Spot Size*1	0.08 mm (3.1 mils)	0.26 mm (10 mils)	0.38 mm (15 mils)
Display Size	8 cm x 10 cm	9.8 cm x 12.2 cm	9.8 cm x 12.2 cm
Acceleration Potential	5.4 kV	22.5 kV	12.0 kV
Bandwidth, X-Y*2	≥3 MHz	≥5 MHz	≥2 MHz
Bandwidth, Z*2	≥5 MHz	≥10 MHz	≥5 MHz
Rise Time	≤35 ns	≤35 ns	≤70 ns
Input R and C, X-Y*3	1 MΩ or 50 Ω "<" ≤47 pF	1 MΩ, "<" ≤60 pF	1 MΩ, ≤ "<" ≤47 pF
Input R and C, Z*3	1 MΩ or 50 Ω "<" ≤47 pF	1 MΩ, "<" ≤60 pF	1 MΩ, "<" < 47 pF
X-Y Phase Difference	≤1° to 500 kHz	≤1° to 1.5 MHz	≤1° to 500 kHz
Recommended Source Impedance, X Y and Z*3	<10 kΩ in 1 MΩ pos.	≤10 kΩ	≤10 kΩ
Temperature Range	0°C to 50°C	0°C to 50°C	0°C to 50°C
Power Requirements*4	75 W	61 W	26 W
Included Accessories	Lined external Implosion shield (graticule) for adjustment purposes.		
Recommended Cameras	C-9 Opt. 07	C-9 Opt. 07	C-9 Opt. 07

**1 Measured at 0.5 μA.*

**2 Full spec would read: "DC to. . ." appropriate figure.*

**3 "<" means "paralleled by less than."*

**4 Line-voltage selector allows operation from 100, 110, 120, 200, 220, and 240 V (±10% on each range), 48 to 440 Hz. Number given shows Watt max at nominal line voltage.*

OPTIONS AND ACCESSORIES

Feature	606B	608	620	Option	Price
Internal Graticule		•	•	Opt. 01	**+$15**
UL 544 (Includes handles, feet, and covers)			•	Opt. 06	**+$140**
UL 544 (Includes handles, feet, and covers)	•			Opt. 06	**+$135**
Screwdriver Front Panel Controls	•			Opt. 07	**+$45**
UL 544 Component Recognized	•	•	•	Opt. 09	**NC**
25-Pin Remote Program Connector		•	•	Opt. 10	**+$55**
AC Delete			• (6,31)*1	Opt. 20	**–$20**
Full Differential Inputs		•		Opt. 21	**+$70**
Extended Gain Range		•		Opt. 22	**+$45**
Handle,feet, and covers			• (6, 28, 31)*1	Opt. 23	**+$120**
Handle,feet, and covers		• (28)*1		Opt. 23	**+$130**
Linearized Z-axis		•		Opt. 24	**+$75**
TTL Blanking		•		Opt. 25	**+$75**
TTL Blanking			•	Opt. 25	**+$50**
Covers only	• (6)*1	• (23)*1	• (6, 23, 31)*1	Opt. 28	**+$90**
Metal Bezel		•		Opt. 29	**+$75**
Delete all Rear BNCs, DC Power Connector and AC Power Supply and Switch			•	Opt. 31	**–$25**
GM (P7) Phosphor		•	•	Opt. 76	**+$65**

**1 Not available with these options.*

ORDERING INFORMATION

606B
Monitor **$5,375**

608
Monitor **$3,320**

620
Monitor **$1,910**

To order, contact your local sales office (listed on the inside back cover).

Display Monitors

Excellent color saturation viewable in high ambient light, wide range of colors, and high resolution for better color definition and viewability.

NU 900M

- Excellent Color Uniformity
- High Resolution
- Ultra-High Contrast
- Large Active Display Area
- AR Coated Front-Glass
- Wide Range of Colors
- Minimal Convergence Error
- Ruggedness
- No Shadowmask Constrictions

APPLICATIONS

- Test and Measurement Products
- Process Control Systems
- Medical Instrumentation
- Avionics Displays

New NU 900M

NU 900M 9-inch Color Display

The Nu 900M is a member of a new family of color display products. Based on a technology called NuCOLOR™, this 9-inch monitor contains a unique combination consisting of a monochrome CRT and a NuCOLOR Shutter. The NuCOLOR Shutter is an electrically switchable color filter made up to two fast liquid crystal optical switches, known as "pi-cells", plus a combination of color and neutral polarizers. Color is produced by sequentially displaying red, green, and blue field information on the monochrome CRT while the Shutter is switched to transmit red, green and blue respectively. Alternate fields, viewed through different colored filters, create full-color images.

ADVANTAGES

The Nu 900M display offers several advantages over conventional shadowmask displays including: contrast ratio of 100:1, resolution that depends on electron beam size of a monochrome CRT, color uniformity created from color polarizers utilizing light energy from a single electron beam, and a ruggedized body ideal for industrial applications.

As a result, Nu 900M offers the user excellent color saturation that is viewable even in high ambient light, a wide dynamic range of colors, no shadowmask constrictions, and high resolution allowing better color definition and viewability.

Characteristics

MONITOR

CRT – 9 in..

Display Area – 6.67 in. x 5.0 in..

Resolution – 640 x 480.

Display Luminance – >30 fL (white).

Contrast – 100:1 @ 42 foot candles.

Geometric Distortion – +0.75%.

Video Risetime – ≤4.4 ns.

Horizontal Scan Rate – 91 kHz.

Input Signal – Composite Serial Video.

ELECTRICAL

Power Input – 87-250 VAC, 48-62 Hz.

Power Consumption – 100 Watts max.

Internal Power – 48 VDC @ 1.5 Amps.

Anode Voltage – 16 kV (typical).

Reliability – ≥33,000 hours (MIL-HNBK-217E).

ENVIRONMENTAL

Temperature – 0° to 50°C.

Humidity – 0 to 90% rel. humidity.

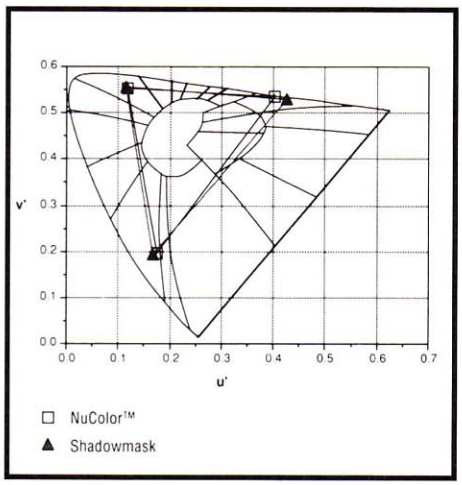
Altitude – 15,000 feet operating; 50,000 feet nonoperating.

MECHANICAL

Safety – UL 1950, CSA-950, IEC 950, EN6950.

Dimension – 9.16 in. (W) x 7.5 in. (H) x 12 in. (L).

Weight – ≤15 pounds.



CIE Coordinates

ORDERING INFORMATION

NU 900M

9 in. Color Display **$950**

Opt. B1 – Service Manual ..... **+$150**

INTERNATIONAL POWER PLUG OPTIONS

Opt. A1 – Universal Euro. 220 V, 50 Hz ..... **NC**

Opt. A2 – United Kingdom. 240 V, 50 Hz ..... **NC**

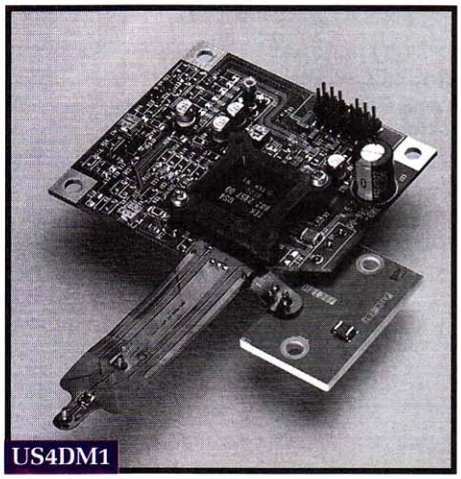
Opt. A3 – Australian. 240 V, 50 Hz ..... **NC**

Opt. A4 – North American. 240 V, 60 Hz ..... **NC**

Opt. A5 – Switzerland. 220 V, 50 Hz ..... **NC**

To order, contact your local sales office (listed on the inside back cover).

Microelectronics


US4DM1

STANDARD PRODUCTS

D/A Converter

The TKDA10 is a high speed ECL DAC. It utilizes precision laser wafer trimming to achieve 12-bit accuracy and a precision 50 Ω complementary output. This DAC can drive 25 Ω lines directly (doubly terminated 50 Ω) allowing easy interfacing to color and monochrome systems. Typical applications include digital frequency synthesis, arbitrary waveform generation, professional video reconstruction, instrumentation, and CAD/CAM workstations.

A/D Converter

Tektronix offers two high speed, 8-bit, fully parallel, ADCs with strobed comparators, latched outputs and an internal track-and-hold. These are the TKAD10C (500 MSPS, with an effective bits performance of 7.0 at 250 MHz) and the TKAD20C (250 MSPS, with an effective bits performance of 6.8 at 125 MHz). Special comparator output design and decoding minimizes metastable states. Typical applications include high energy physics, radar/sonar, instrumentation, communications, medical electronics, and high speed image processing.

Video Display Drivers

The TKDD10P, US1 and US4DM1 are high performance transconductance amplifiers with high voltage open collector outputs capable of driving a video display (CRT) directly. The TKDD10P is a high voltage monolithic IC with variable gain that has typical transition times of 2.2 ns into 6 pF. The US1 is a thin-film hybrid amplifier with typical transition times of 0.9 ns into 3.5 pF. The US4DM1 is a complete video amplifier board product, supplying all support circuitry and connection to the CRT for either an anode or cathode connected system. A patented flex connection allows typical transition times of 1.5 ns into 4.5 pF. The US4DM1 provides ESD protection, DC restore, blanking, sync stripping and variable gain. Typical applications for these products include ultra-high speed and high resolution displays.

LaserDriver/Controller

The LDC 600 Laser Driver/Controller is a high speed amplifier with high output current (85 mA) capable of driving laser diodes to 600 MB/s. The LDC 600 features 50 Ω differential ECL inputs and user adjustable modulation and forward current. Applications include digital fiber optic communications, digital video, local area networks, optical signal generation, and optical source testing. An evaluation kit including an LDC 600 for benchtop analysis of laser diode modules is also available.

Laser Diode Modules

Tektronix offers LDMs with emission wavelengths of 1300 and 1550 nm. These laser products feature a standard output power of 1 mW (guaranteed minimum) coupled into a low bend loss single-mode fiber. Two packages are available: a pin-compatible with industry standard, 14-pin DIP package; and an exceptionally small and rugged 8-pin DIP package suitable for surface mounting. Applications include optical fiber communications, fiber optic sensors, and low loss video links.

STANDARD PRODUCTS

- D/A Converters
- A/D Converters
- Video Display Drivers
- Laser Driver/Controller
- Laser Diode Modules

BIPOLAR ASIC PRODUCTS

- Semi Custom ICs
- Full Custom ICs
- State-of-the-Art Design Tools
- 6.5 GHz, 8.5 GHz, and 12.5 GHz Analog and Mixed-Signal Processes

HYBRID PRODUCTS

- Tested Electronic Subassemblies
- Custom Designed Hybrid Circuits
- Thick or Thin Film Technologies

IC and hybrid circuit design and fabrication capabilities for those who have high performance requirements.

SELECTION GUIDE

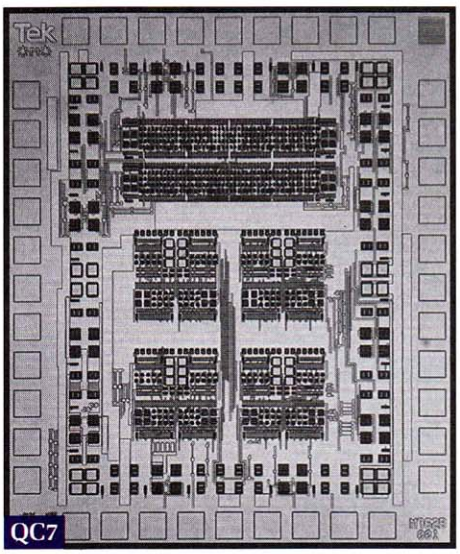
D/A Converters and A/D Converters	Resolution	Accuracy	Conversion Rate	Maximum Integral Linearity Error
TKDA10 (D/A)	6-bit	12-bit	100 MSPS	±0.01 LSB
TKAD10C (A/D)	8-bit	7.0 effective bits at 250 MHz	500 MSPS	±0.5 LSB
TKAD20C (A/D)	8-bit	6.8 effective bits at 125 MHz	250 MSPS	±0.5 LSB
Video Display Drivers	**T_{trans}**	**C_L**	**V_0**	**Gain**
TKDD10P	2.2 ns	6 pF	50 Vp-p	0 to 80
US-1	0.9 ns	3.5 pF	55 Vp-p	48
US4DM1	1.4 ns	4.5 pF	55 Vp-p	0 to 80

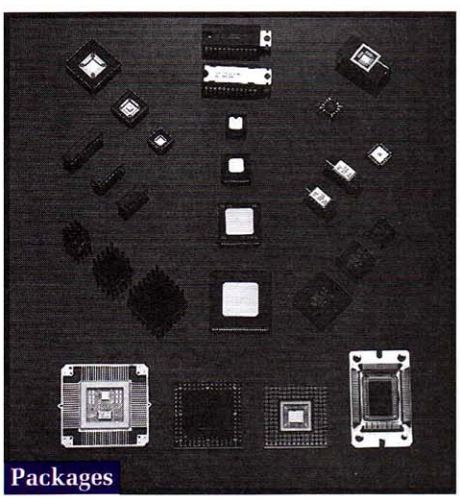
Laser Driver/Controller	Modulation	Input	Output Current
LDC 600	600 MB/s	50 Ω diff. ECL	85 mA

Laser Diode Modules	Wavelength	Package
LDM 1300/LDM 1550	1300 nm/1550 nm	8-pin CERDIP
LDM 1301/LDM 1551	1300 nm/1550 nm	14-pin Kovar DIP

Continued on next page.

Microelectronics





QuickCustom™ Bipolar Analog ICs

QUICKCHIP™

The QuickChip™ approach consists of a series of IC arrays (see picture) and easy to use, time saving design tools. QuickChips have a basic "core" array of transistors, capacitors, and resistors, optimally configured for interconnection. The designer adds custom two level metallization. In addition to the implanted resistors, laser trimmable nichrome resistors may be added. Once final designs are determined and approved, finished wafers can typically be delivered within four weeks.

QUICKTILE™

The QuickTile design method uses standard blocks of tiles (containing transistors, resistors, capacitors, bond pads, etc.) that are placed by the designer to suit the desired circuit function. To use this method, the designer merely selects appropriate tiles from a library. These are then "snapped" together on a coarse grid, thus eliminating the risk of violating layout rules. A design library of analog and digital functions is available.

FULL CUSTOM

ICO also offers a full custom design approach for maximum performance and minimum die size. Typical delivery of finished wafers is less than 12 weeks from approval of design layout.

DESIGN TOOLS

Tektronix' startup packages include a powerful CAD software package (QuicKic™) that offers schematic entry, netlist generation, layout with verification, design rule checking, electrical rule checking, and bonding diagram creation. Also included is a complete training manual including a design guide, design consultation by our experienced design staff, and device models that accurately predict circuit performance over temperature. Tektronix model libraries support industry standard circuit simulators as well as the Tektronix simulator, TEKSPICE.™ A proprietary electrical rules checker, QuERC,™ is also provided to examine the DC bias conditions as provided by a circuit simulator. Using a data base of process and device limitations, QuERC identifies potential design problems early in the development process. An experienced Tektronix Product IC Engineer is assigned to each project.

IC FABRICATION PROCESSES

In addition to the standard processes (SH3 and SHPi), Tektronix now offers a new 12+ GHz process. This Giga-speed Si bipolar Technology (GST-1) is a self-aligned double poly process featuring NPN transistors with $f_T > 12$ GHz, as well as Schottky diodes, poly resistors, and trimmable nichrome resistors. It uses a deep trench isolation that increases density and reduces parasitics, resulting in a 2X density improvement over SHPi (in QuickChip format). GST-1 is available both in QuickChip 7, as an uncommitted mixed analog/digital array, and in full custom, for maximum performance and minimum die size.

The QuickChip 2 family is fabricated with the junction isolated SH3 process. The QuickChip 6 family uses the oxide-isolated, double-implant SHPi process.

PACKAGING

Tektronix offers a full array of packaging capabilities and associated services. Package options include Tektronix standards (such as PDIPs, CDIPs, QUADs, and Cerquads), as well as other industry standard packages and custom multilayer ceramic chip carriers and hybrids.

Hybrid Components

DESIGN, TEST, AND FABRICATION SERVICES

Tektronix provides design services for hybrid circuits using thick or thin film substrates and ASICs. Customer provided designs can also be fabricated. Custom and commercial test and trim systems perform AC tests with active and passive trimming of resistors and capacitors to meet tight design tolerances. Reliability testing, burn in and mechanical tests are available. Rapid turn around on designs and prototypes is assured by experience with products for ATE pin drivers, video drivers and precise, high frequency circuits.

QUICKCHIP SELECTION GUIDE

QuickChip 2 Family (6.5 GHz)	2S	2	2L	2K-30	2K-130
NPNS	50	214	524	78	280
PNPs	82	110	240	38	146
Resistors	602	946	2064	258	1118
Capacitors	24	20	72	10	30
Bond Pads	24	36	70	22	44
Schottky Diodes	0	0	0	64	182

QuickChip 6 Family (8.5 GHz, 4X Density of QC2, JFETs)	6-10	6-40	6-120
NPNs	74	224	600
PNPs	25	100	300
JFETS	12	48	144
Schottky Diodes	44	104	240
Resistors	340	1360	4080
Capacitors	4	16	48
Bond Pads	18	32	54

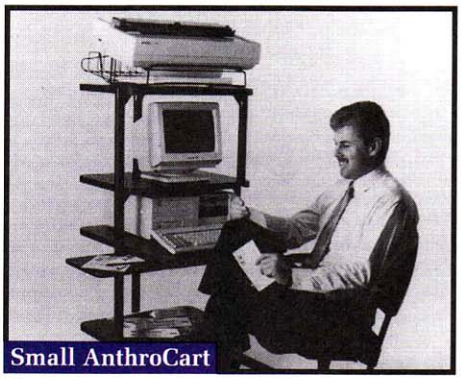
QuickChip 7 (12.5 GHz, 2X Density of QC6)	
Small NPNs	496
Medium NPNs	48
Large NPNs	48
PNPs	56
Schottky Diodes	64
ESD Diodes	64
2 kΩ Resistors (analog)	400
2 kΩ Resistors (digital)	464
400 Ω Resistors	544
MOS Capacitors	24
MOS/junction Capacitors	24
Bond Pads	40

QuickTile™ and Custom Arrays
Customer Designed

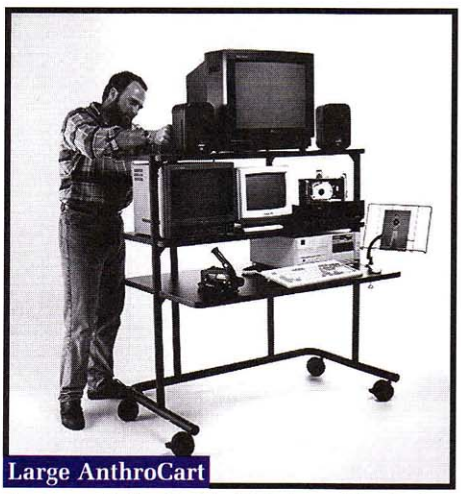
CONTACT INFORMATION

Microelectronics Product Line
P.O. Box 500, Mail Sta. 59-420
Beaverton, OR 97077
Phone: (503) 627-2515
FAX: (503) 627-5560

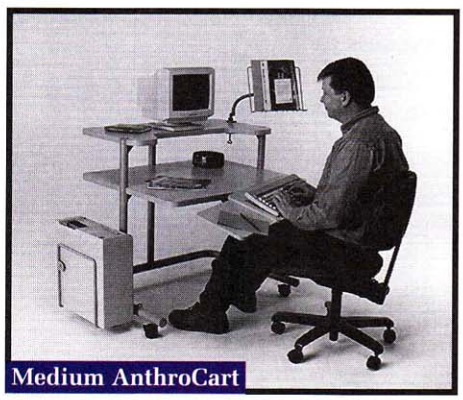
Anthro
Technology Furniture


Small AnthroCart

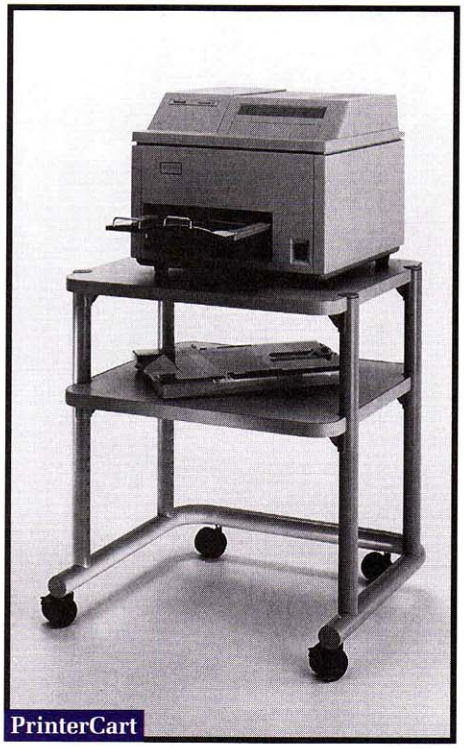
The most compact cart is the Small AnthroCart. It is 24 inches wide and is perfect for people who have to share a computer, or move hardware around.


Large AnthroCart

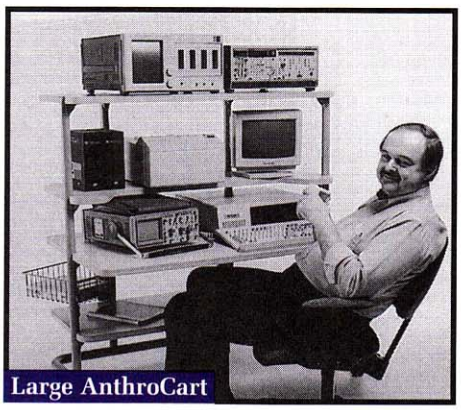
The Large AnthroCart is 48 inches wide. It gives you all the advantages of the Small and Medium carts, but with lots more room to spread out. It also makes a good foundation for building a workstation.


Medium AnthroCart

The Medium AnthroCart (36 inches wide) is small enough to easily move around, and the additional foot of space is great if you use a mouse or need additional writing space.


PrinterCart

Anthro PrinterCart.


Large AnthroCart

The Large AnthroCart is ideal for test and measurement equipment. The Cart has an Extension Shelf Kit, Wrist Support, Storage Basket, and Additional Small Shelf underneath.

Continued on next page.

AnthroCarts®

- Choose Different Sizes and Colors to Meet Your Needs
- Four Basic Sizes
  Small (24 in.)
  Medium (36 in.)
  Large (48 in.)
  Extra Large (60 in.)
- Lifetime Warranty
- Rugged Construction, Holds up to 150 lbs.
- Made in U.S.A.
- Over 30 Accessories to Customize Your Workstation
- Mobile
- Space Saving

APPLICATIONS

- Organize any Type of Hardware (scopes, computers, audio visual products)
- Rack Equipment
- Available for OEM Applications

ANTHRO™
1-800-325-3841
(in U.S. only)

Technology furniture for use with any type of hardware, from scopes to personal computers to graphic terminals.

Anthro
Technology Furniture

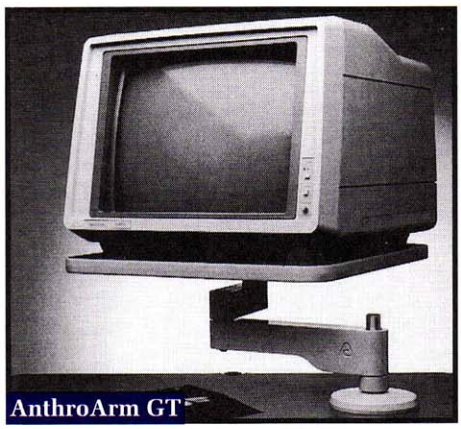
AnthroArm, AnthroCarts, AnthroBench

The AnthroArm is a "tank"– this arm holds up to 200 lbs. and can withstand the most outrageous abuse. The AnthroArm GT may be the sturdiest arm you'll ever come across.

Both the arm and the platform swivel 360 degrees so you can move your equipment to the right spot. You can choose the reach you need, 12 in. or 18 in., and the platform size: 13 in., 17 in. and 21 in. The AnthroArm is available in Black and Putty Grey.

The AnthroBench was designed as an engineering workstation for Tektronix' use. It is very spacious (60 in. x 36 in.) and very strong (holds up to 600 lbs.).

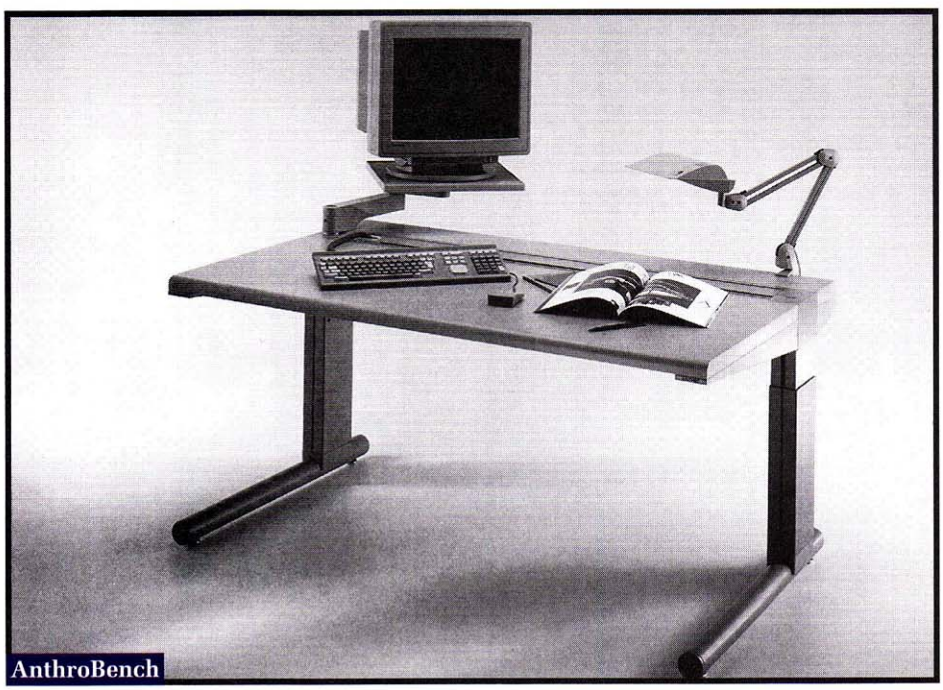
The AnthroBench has some great features: a cord management channel running the length of the table, height adjustability from 23 in. to 33 in., and the ability to hold two monitors on moveable arms.


AnthroArm GT

Anthro Arm can easily hold a 200 lb. graphics monitor.

MiniCart

The MiniCart is the smallest AnthroCart you can buy. It was designed for small test equipment (like scopes), medical hardware, fax machines, postage machines or small monitors.


AnthroBench

The Extra Large AnthroCart has 60 inches of work surface – that's a lot of space. It is ideal for demonstration rooms, training facilities and when you need to spread out blueprints or drawings.

Ultra Compact Cart

The Ultra Compact Cart is for tiny spaces. It is extremely handy to pull out when you need your computer, and to tuck away when you don't.

VideoCart

The Anthro VideoCart is a perfect solution for presentation centers, conference rooms and training facilities. The Video Cart easily accommodates most TV monitors and securely holds them in place with the Safety Strap.™

Anthro
Technology Furniture

Proudly made in the U.S.A.

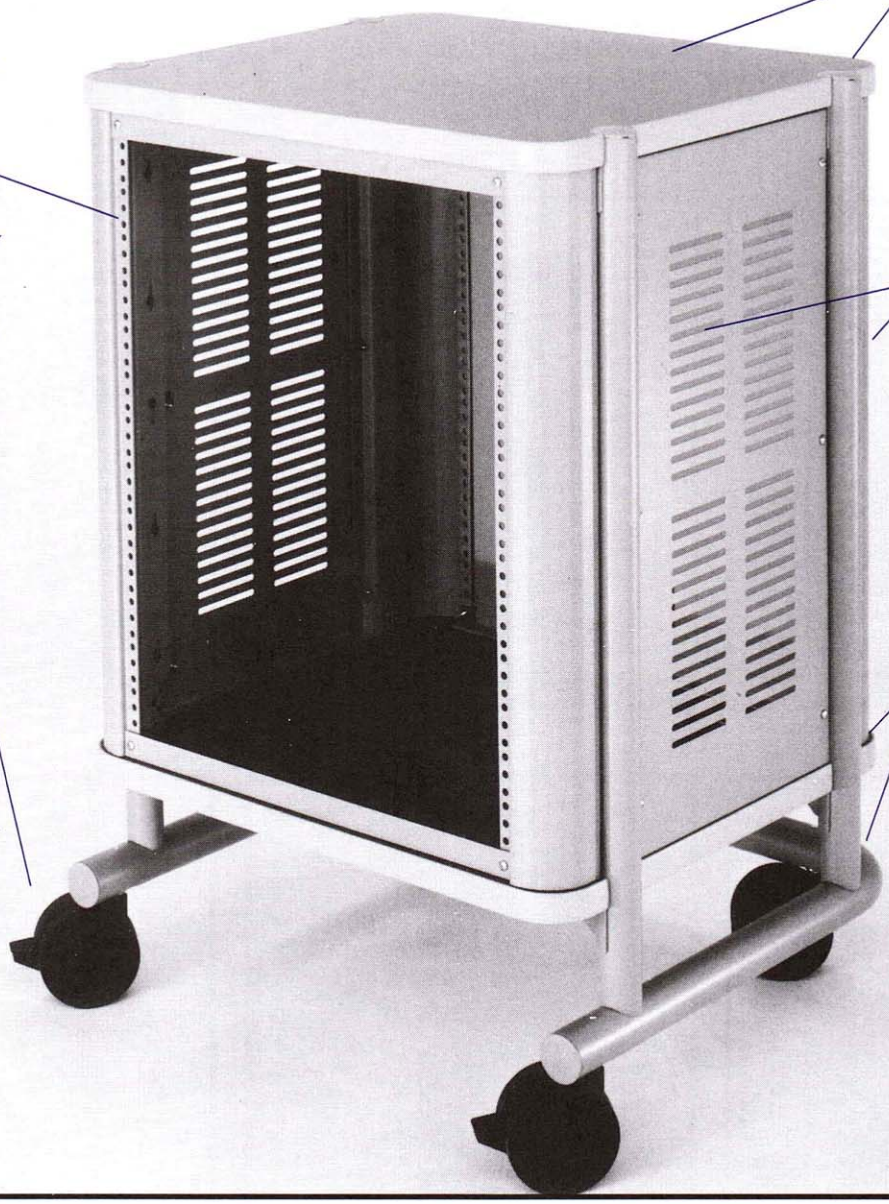
Lifetime Warranty *Just call us if anything should ever go wrong. We'll quickly replace the piece in question.*

Tapped mounting rails. *Our front and rear tapped mounting rails make it easy for you to mount your equipment. More convenient than clips, and more secure.*

Satisfaction guaranteed. *If for any reason, at any time, you are unhappy with your Anthro product, call us on our 800# and we'll make it right.*

Mobile. *Large soft rubber, 4 in. twin wheel castors are quiet and easy to roll. The two front castors are locking.*

Color choices. *You can choose between black, bone and dark grey.*



Built for long hard use. *We use high pressure, scratch resistant laminate. Our vinyl t-molding prevents dings on the edges. The baked on powder coat paint finish is the toughest finish available and keeps paint looking new and unmarred.*

Removable side and rear panels. *The RackCart's side and rear panels are offered as accessories. You have them only if you need them. The rear panel pops on and off easily so you don't have to deal with screws. Vented on the sides and rear; 2 grommets on the rear panel for cords.*

Strong. *The RackCart easily holds up to 600 lbs. of your equipment. It is constructed of 16 gauge steel tube, 1 in. thick 45 lb. industrial grade particle board, and 14 gauge rounded steel corners.*

Anthro RackCart Towers

- Available in 4 heights
- Lifetime Warranty
- Unique high tech look
- 3 Colors to choose from (all black, dark grey with putty tubes and panels, or bone with putty tubes and panels)
- Many accessories to add

The RackCart Tower is not only a practical and very sturdy way to hold your equipment, it also has a truly distinctive look and feel to it. You'll see the difference immediately as you assemble the Tower and mount your equipment.

Continued on next page.

Anthro
Technology Furniture

Anthro RackCart Towers and Workstations

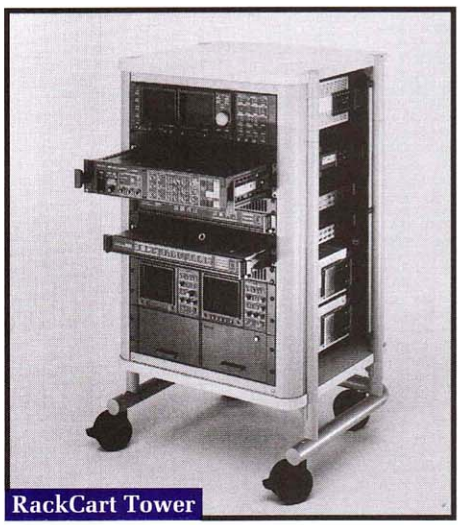
- Available in several heights and depths
- Lifetime Warranty
- Unique high tech look
- 3 Colors to choose from (Black, Dark Grey, and Bone)
- Many ergonomic accessories available

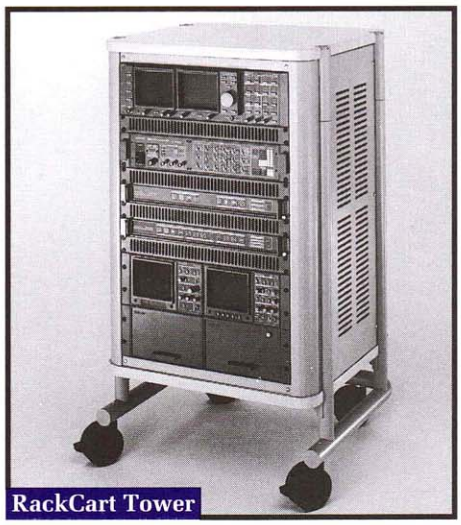
Anthro RackCarts are not only a practical and sturdy way to hold your racked equipment, but they also have a distinctive look and feel.

Our RackCart Towers are available in 4 heights. Additional accessories include fixed shelves, slide-out shelves, drawers, and panels for the rear and sides.

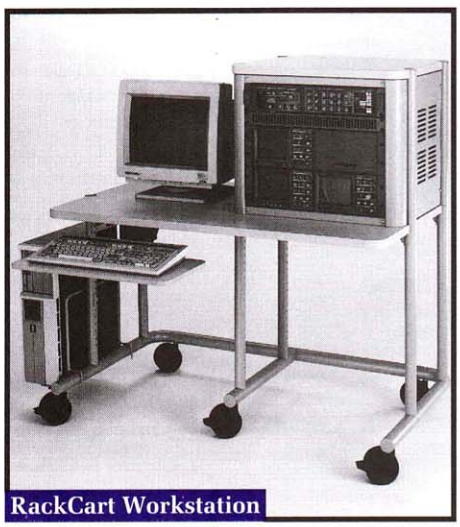
Anthro RackCart Workstations combine rack cabinets with our 48 in. wide carts for a versatile and flexible work area.

You may choose a 30 in. or 36 in. deep workstation and add rack space above or below your worksurface. And there are lots of accessories for you to customize your workstation.


RackCart Tower


RackCart Tower

RackCart Tower


RackCart Workstation

RackCart Workstation

RackCart Tower

ORDERING INFORMATION

Anthro® Corp. Technology Furniture®
3221 NW Yeon St. Portland, OR 97210
Phone: 503:241-7113
Fax #: 503-241-1619

ANTHRO™

For a Free Catalog:
CALL OUR TOLL FREE NUMBER: 800-325-3841 (U.S.only)

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General Customer Information

CONTENTS

TEKTRONIX CONTACTS
National Marketing Center 520
TekDirect 520
Distributors.....520, 540
Sales/Service Offices 520, 536

CUSTOMER SUPPORT/SERVICE
General Information.....521
Warranty Summaries.....522, 523
Service Offerings.....524-527
RECONDITIONED INSTRUMENTS 528
TRAINING/SEMINARS.....529

PURCHASING/ORDERING
Credit.....530
GSA Contract.....530
Rental/Leasing.....530
OEM Components.....531
Power Cords/Plugs.....531
LITERATURE APPLICATION NOTES 532

SALES/SERVICE OFFICES LISTING
International 536-539
U.S. .....Inside Back Cover
DISTRIBUTORS LISTING 540
REPRESENTATIVES LISTING 540

Customer Support

Quality, support, and convenience.

- Tektronix Sales Offices
- Tektronix Distributors
- Tektronix Representatives
- NMC
- TekDirect

Tektronix has a number of ways for you to get information or place your order. Tektronix sales offices worldwide are open and ready to help. In addition, we are partnering with authorized Tektronix Distributors and Representatives to provide you with fast and convenient service for selective Tektronix products. Call, toll free 1-800-426-2200 Ext. 99 for the name of the distributor or representative that serves you. Calling the toll free number above and requesting Ext. 99 also puts you in touch with our TekDirect Catalog Group, they offer many benefits as described below.

Tektronix Sales Service Offices

Tektronix products and technical support are available through a worldwide network of sales offices. Your nearest Tektronix Account Manager is available to answer your questions. To find the sales office nearest you, refer to the list on the inside back cover.

Authorized Tektronix Distributor and Manufacturers Representatives

We have Authorized Tektronix Distributors and Manufacturers Representatives for selective products and geographic areas. They will provide you with fast, convenient service and support. You may already be served by them, so ask if they carry Tektronix. We encourage you to take advantage of their support and purchase Tektronix products from them.

As you use this catalog watch for the (TD) icon. It identifies those products that are available through our distributors and representatives. For a listing of their names refer to page 540. Also we are adding new ones all the time to better serve you needs, so call 1-800-426-2200 Ext. 99 for the one nearest you.

Watch for products identified as Tektronix Distributor (TD).

Tektronix National Marketing Center (NMC)

The same quality support found in our sales and service offices is available toll free. Call 1-800-426-2200, Ext. 99, Monday through Friday, from 8:00 am Eastern Time to 5:00 pm Pacific Time. Expert telephone sales engineers are available to provide technical support to help you choose the right equipment, answer questions, and take your order.

TekDirect

Call Direct – 1-800-426-2200. TekDirect provides all the same great benefits as above, plus VISA or MasterCard accepted, 24 hour shipping with rush delivery available. TekDirect also provides the inside track to the latest trends in test and measurements. Great reconditioned equipment bargains are also available.

Billing – is any way you like. VISA or MasterCard accepted. Or set up an account with Tektronix (30-, 60-, 90- day payment). Checks or money orders are also accepted. For future orders, ask us about pre-approved lines of credit.

Shipping – Anything you order from the TekDirect Catalog will be shipped within 24 hours. And if you use one of our regular surface carriers, we'll even pay shipping charges (except Alaska and Hawaii).

Need your gear in a day or two? We can also deliver via 1-day, 2-day, or overnight air services, at low rates.

Guarantee – When you buy once from TekDirect, we want you to be a satisfied customer for life. To support that goal, we offer a 30-day, money-back guarantee. If you return any purchase within 30 days, we'll either replace your instrument, exchange it for another one, or give you a refund. No questions! No bother!

Service – If you need to return something for calibration or repair, just drop it off at a Tektronix service center. Or mail it in. We offer a service agreement that provides 7-day turnaround time. Of course, we always pay the return freight.

Watch for products identified as Tektronix Distributor (TD).

Customer Support

Total Solutions for Your Success

When you purchase your Tektronix product, you will find more in the box than a quality product. You'll find an array of services that provide total-solution coverage – coverage that begins with the first call to your customer service representative and continues after the sale through long-term product support. Our sales and service personnel work closely to help you make the best selections for your applications. Then we help you maximize your investment by ensuring optimum product performance. All this is accomplished through customer support programs ranging from training to product installations and a variety of maintenance plans.

It all begins by contacting a customer service representative (CSR) located in your nearest Tektronix sales and service office. Our U.S. and international office locations are listed at the back of this catalog. The CSR will give you information on products and the names of sales engineers assigned to serve your product interests.

WARRANTY COVERAGE
All Tektronix products are warranted to be free from defects in materials and workmanship during the applicable warranty period. See pages 522 to 523.

SERVICE OFFERINGS
Simply tell us what you need – there is a good chance that we have already developed a service solution you will like. If not, we will gladly create a service package to complement your current goals and will partner with you to anticipate your future requirements. See pages 524 to 527 for specific service offerings.

CUSTOMER-SITE INSTALLATIONS
Tektronix provides on-site installations for most Tektronix-configured systems. Your Tektronix specialist will set up your product to meet all operating specifications. Contact your local sales and service office for more information.

TECHNICAL SUPPORT
For technical application assistance by phone, call 1-800-835-9433 x2400, between 6AM and 5PM Pacific Time.

LONG TERM PRODUCT SUPPORT
Tektronix has a long-standing policy to provide service coverage after a product has been removed from the catalog. These products can be serviced pending part availability. Contact your local Tektronix service center for service quotes and information.

TRAINING AND ASSISTANCE
Your Tektronix product is most useful to you when you are thoroughly familiar with it. Formal training classes and self-study aides can help you get up to speed faster. Ask your Tektronix sales representative for details about customer training.

SEMINARS
To receive information about our free Tektronix product and technical seminars, contact your local sales office to be added to the seminar mail list. See page 529.

OPERATIONAL AND APPLICATIONS SERVICE TRAINING WORKSHOPS
To help you achieve optimum utilization of your equipment, Tektronix provides fast-paced courses with classroom lectures and supervised hands-on laboratory sessions. Participants receive manuals and workbooks containing detailed course notes and lab exercises. For added convenience, Tektronix also offers private workshops conducted at your company. See page 529.

MODULE EXCHANGE SERVICES
Easily exchangeable modular components facilitate rapid troubleshooting and repair of many Tektronix products. You may choose to diagnose a problem and specify the module to exchange, or a Tektronix Customer Service technician can provide assistance. Typically your module order will ship from our dock within 24 hours, and overnight delivery can be arranged for most US locations. To place an order, call the Tektronix *Fast*Parts Center at 1-800-848-5083.

REPLACEMENT PARTS
Components of equal or improved quality can be supplied for over 5,000 Tektronix products. Replacement parts and supplies can be ordered by calling toll free between 5AM and 5PM, Pacific Time. Most items are stocked and will ship from our dock within 24 hours of order placement. Overnight shipment is available upon request. Call the Tektronix *Fast*Parts Center at 1-800-848-5083.

CUSTOMER SUPPORT PROGRAMS

- Service Offerings
- Warranty Coverage
- Customer-Site Installations
- Technical Support
- Training and Assistance
- Product and Technical Seminars
- Operational and Applications Workshops
- Service Training Workshops
- Module Exchange Services
- Replacement Parts
- Long-Term Product Support

Providing you with worldwide service and support to complement your new product purchase.

ORDERING INFORMATION

CONTACT INFORMATION
Contact your Tektronix sales representative or any Tektronix Sales and Service office for additional service information. Or request a copy of the new Tektronix Test and Measurement Service brochure with accompanying inserts detailing service options. See pages 536 through 539 for the Tektronix office nearest you.

Warranty Summary

Warranty Summaries

Software Warranty Summary

Tektronix warrants that its software products will conform to the specifications in the documentation provided with the product, when used properly in the specified operating environment, for a period of three (3) months. The warranty period begins on the date of shipment, except that if the program is installed by Tektronix, the warranty period begins on the date of installation or one month after the date of shipment, whichever is earlier. If the software product does not conform as warranted, Tektronix will provide the remedial services as described in the documentation provided with the product.

For products offered without documentation, Tektronix warrants that the media on which the software product is furnished and the encoding of the programs on the media will be free from defects in materials and workmanship for a period of three (3) months from the date of shipment. If any such medium or encoding proves defective during the warranty period, Tektronix will provide a replacement in exchange for the defective medium. Except as to the media on which the software product is furnished, the software product is provided "as is" without warranty of any kind, either express or implied.

Tektronix does not warrant that the functions contained in any software product will meet Customer's requirements or that the operation of the programs will be uninterrupted or error-free.

In order to obtain service under this warranty, Customer must notify Tektronix of the defect before the expiration of the warranty period and, for warranted products, make suitable arrangements for such service in accordance with the instructions received from Tektronix. If Tektronix is unable, within a reasonable time after receipt of such notice, to provide remedial service for warranted products or, for "as-is" products, to provide a replacement that is free from defects in materials and workmanship, Customer may terminate the license for the software product and return the software product and any associated materials for credit or refund.

The above warranties shall not apply to any software product that has been modified or altered by Customer. Tektronix shall not be obligated to furnish service under this warranty with respect to any software product a) that is used in an operating environment other than that specified or in a manner inconsistent with the User's Manual and documentation; or b) when the software product has been integrated with other software if the result of such integration increases the time or difficulty of analyzing or servicing the software product or the problems ascribed to the software product.

THE ABOVE WARRANTIES ARE GIVEN BY TEKTRONIX WITH RESPECT TO THE LISTED PRODUCTS IN LIEU OF ANY OTHER WARRANTIES, EXPRESS OR IMPLIED. TEKTRONIX AND ITS VENDORS DISCLAIM ANY IMPLIED WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE. TEKTRONIX' RESPONSIBILITY TO PROVIDE REMEDIAL SERVICE WHEN SPECIFIED, REPLACE DEFECTIVE MEDIA, OR REFUND CUSTOMER'S PAYMENT, AS APPLICABLE, IS THE SOLE AND EXCLUSIVE REMEDY PROVIDED TO CUSTOMER FOR BREACH OF EITHER WARRANTY. TEKTRONIX AND ITS VENDORS WILL NOT BE LIABLE FOR ANY INDIRECT, SPECIAL, INCIDENTAL, OR CONSEQUENTIAL DAMAGES IRRESPECTIVE OF WHETHER TEKTRONIX OR THE VENDOR HAS ADVANCE NOTICE OF THE POSSIBILITY OF SUCH DAMAGES.

Warranty Summary

Hardware Warranty Summary

Tektronix warrants to its Customers that the products that it manufactures and sells will be free from defects in materials and workmanship for the periods set forth in the table below. If any such product proves defective during the applicable warranty period, Tektronix, at its option, either will repair the defective product without charge for parts and labor or will provide a replacement in exchange for the defective product.

In order to obtain service under this warranty, Customer must notify Tektronix of the defect before the expiration of the warranty period and make suitable arrangements for the performance of service. Tektronix will provide such service at Customer's site for certain categories of products, as indicated in the table below, if Customer's site is within the normal on-site service area. Tektronix will provide on-site service outside the normal on-site service area only upon prior agreement and subject to payment of all travel expenses by Customer. In all other cases, Customer shall be responsible for packaging and shipping the defective product to the service center designated by Tektronix, with shipping charges prepaid. Tektronix shall pay for the return of the product to Customer if the shipment is to a location within the country in which the service center is located. Customer shall be responsible for paying all shipping charges, duties and taxes, if the product is returned to any other location. The locations at which the services will be provided for different categories of products or product groups are set forth below.

This warranty shall not apply to any defect, failure or damage caused by improper use or improper or inadequate maintenance and care. Tektronix shall not be obligated to furnish service under this warranty a) to repair damage resulting from attempts by personnel other than Tektronix representatives to install, repair, or service the product; b) to repair damage resulting from improper use or connection to incompatible equipment; or c) to service a product that has been modified or integrated with other products when the effect of such modification or integration increases the time or difficulty of servicing the product.

THIS WARRANTY IS GIVEN BY TEKTRONIX WITH RESPECT TO THE LISTED PRODUCTS IN LIEU OF ANY OTHER WARRANTIES, EXPRESS OR IMPLIED. TEKTRONIX AND ITS VENDORS DISCLAIM ANY IMPLIED WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE. TEKTRONIX' RESPONSIBILITY TO REPAIR OR REPLACE A DEFECTIVE PRODUCT IS THE SOLE AND EXCLUSIVE REMEDY PROVIDED TO THE CUSTOMER FOR BREACH OF THIS WARRANTY. TEKTRONIX AND ITS VENDORS WILL NOT BE LIABLE FOR ANY INDIRECT, SPECIAL, INCIDENTAL, OR CONSEQUENTIAL DAMAGES IRRESPECTIVE OF WHETHER TEKTRONIX OR THE VENDOR HAS ADVANCE NOTICE OF THE POSSIBILITY OF SUCH DAMAGES.

General Product Categories*	Warranty Period	Service Location
Oscilloscopes: Including 2205, 2402, and 2402A TekMate (except all other 2200, 2300, 2400 Series), 114xx Series/Plug-ins, DSA6xx, SDxx, CSAxxx Series; TM 250,TM 500/TM 5000 Series; Cable Network Analyzers; Logic Analyzers (except 9200 Series); Spectrum Analyzers (except 305x DSP Systems); Television Products (except 17xx Series, WFM300A); Waveform Digitizers; Curve Tracers; Photometers/Radiometers; Cameras; Carts; Probes; CRTs; Isolators; Test System Interface Series; XP Series X-Terminals; XPTA Graphics Tablet; 468x and 469x Series Color Printers (except 4693, 4696, and 4697 Printers); TestLabs; Fourier Analyzer; RIC386 Instrument Controller; Signal Analyzer; Pulse Generator; RF16x Down Converter; CT100	1 year from date of shipment	Service Center designated by Tektronix
Oscilloscopes: 222 Series, 224, 2200 (except 2205), 2300, 2400 Series (except 2402 and 2402A TekMate), TAS400 Series, TDSxxx Series; Television Products: 17xx Series, WFM300A; Card Modular Instruments: 53A Series, 73A Series, VXxxxx Series	3 years from date of shipment	Service Center designated by Tektronix
Monitors: 606B, 608, 608YX, 620, 634, GMA 201, GMA 202, GMA 212, GMA 213C, GMA 213S	3 months, except 1 year from date of shipment for CRT	Service Center designated by Tektronix
4000 Series: Color Graphics Terminals (except those listed below), Color Printers 4693, 4696, and 4697, Graphics Tablets; Microprocessor Development Products (except V-Systems, MV Systems); 9200 Series Application Software; 305x DSP Systems	3 months, except 1 year from date of shipment for CRT	Customer's site if within normal on-site service area
Color Graphics Terminals: 4205, 4207; Color Graphics Netstation: 4211; Digital Analysis Systems; 9200 Series (except 9200 Series Application Software); LV500 Series	1 year from date of shipment	Customer's site if within normal on-site service area
Systems: SCAL101, SCAL102; Microprocessor Development Products: V-Systems, MV Systems	3 months, except 1 year for CRT, beginning on the date of installation by Tektronix, or one month from date of shipment, whichever is earlier	Customer's site if within normal on-site service area
Parts, Assemblies, Supplies and Test Fixtures: All 9-digit part numbered items (except Probes, CRTs) LCS: SGS 4xx, SGS 6xx; CAChe: CAxx, CAxxx, CGxx, RP88xx...	3 months from date of shipment	Service Center designated by Tektronix
Service	3 months from date of shipment or date of completion if performed on-site	Location where original service was performed

**Supplemental Individual Warranty Statements are available from your local Tektronix Sales Office.*

Warranty-Plus Protection

Our Unconditional Service Guarantee

"If, for any reason, our services fail to fully meet your requirements as promised, we will resolve the problem at our expense."

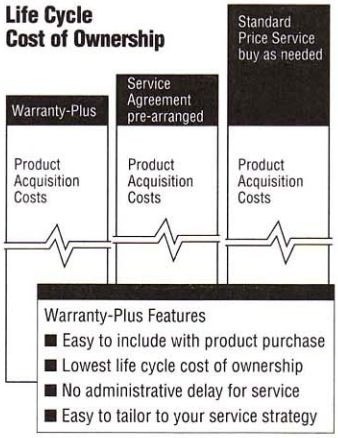
WARRANTY–PLUS PROTECTION

- Calibration
- Repair
- Calibration and Repair
- Comprehensive Systems Services
- On-Site Services

Because every industry and company is unique, we tailor our services to your individual requirements. You may choose from our standard services, mix established custom services, or work with us to create a unique service package adapted to your needs. Whatever your need, for services performed at your location or at a Tektronix Service Center, Tektronix Test and Measurement Service will provide fast, flexible, consistent service that keeps your products operating at peak performance.

WARRANTY-PLUS PROTECTION

The purchase of a Warranty-Plus option at the time of your new product purchase will provide you with the most cost effective, long term service support available from Tektronix.



Warranty–Plus can be secured only as a one time investment on new purchases. Don't miss this prime opportunity. Your Tektronix sales representative can provide information about what options are available for the products you choose. Warranty–Plus options can be included on the product purchase order, or if you prefer, we can invoice it separately.

Warranty–Plus protection is available in a number of combinations, as calibration only, repair only, or calibration and repair in one offering. Service can be performed at your local Tektronix Service Center or, for many products, at your place of business.

WARRANTY–PLUS CALIBRATION

Purchase of Warranty–Plus Calibration allows you to keep your instruments working at peak precision, and with regularly scheduled calibration intervals, ensures your calibration certification is current. The price is well below what you would expect to pay if you waited to recalibrate and recertify your instruments as they became due.

Our calibration program provides NIST traceability and MIL–STD–45662A compliance at no additional charge, on all eligible products. This includes a Certificate of Traceable Calibration and calibration label showing our certification date and the due date for next calibration.

The Certificate of Calibration describes your instrument's condition, the measurement standards we used, and the environmental conditions at the time of calibration. Your product is entered into our calibration records and recall system. We notify you when it is time to schedule recalibration to maintain your instrument's certification, and we maintain audit documentation of your instrument's performance in compliance with MIL–STD–45662A.

WARRANTY–PLUS REPAIR

Priced significantly lower than the cost of even a single repair, extended repair protection can be arranged at the time of your instrument purchase. And, because it is arranged in advance, Warranty–Plus Repair coverage minimizes administrative delays in the unlikely event your instrument ever needs a repair.

Should it become necessary, we will repair your instrument, installing any component modification needed to make the repair. We then conduct a full front panel check, verifying externally accessible adjustments, to enable your instrument to be calibrated to perform within its specifications. To ensure optimum performance, we encourage you to have us calibrate your instrument when we repair it.

WARRANTY–PLUS CALIBRATION AND REPAIR

To ensure full coverage of your newly purchased instrument, the combination of Warranty–Plus Calibration and Repair protection is available for your convenience. This service combines the features of Calibration and Repair in one simple purchase.

WARRANTY–PLUS COMPREHENSIVE SYSTEMS SERVICES

This service, available for most Tektronix Test and Measurement Systems, combines the features of Warranty–Plus Calibration and Repair protection with access to our Telephone Support Center and extended software support.

WARRANTY–PLUS ON–SITE

Warranty–Plus protection can be provided for many products at your location. Our On–Site Warranty–Plus protection saves you the cost of shipping, and allows you to keep your instruments in place – a particular advantage for instruments integrated into larger systems. All the features of Warranty–Plus Calibration and Repair apply.

ORDERING INFORMATION

CONTACT INFORMATION

Contact your Tektronix sales representative or any Tektronix Sales and Service office for additional service information. Or request a copy of the new Tektronix Test and Measurement Service brochure with accompanying inserts detailing service options. See pages 536 through 539 for the Tektronix office nearest you.

Comprehensive Systems Services

These services are available for many Tektronix Test and Measurement Systems and combine the features of calibration and repair agreements as well as access to our Telephone Support Center and extended software support. A variety of services are available dependent on where you prefer the service to take place, at your site or at a Tektronix Service Center.

Customer–Site Services

The following services are provided at your site:

SHARED SERVICE AGREEMENTS
You provide the first line of response; Tektronix provides spares support and telephone assistance. If we can't help you over the phone to have your system fully functional within 24 hours, we provide back–up support at your site from one of our systems technical support specialists.

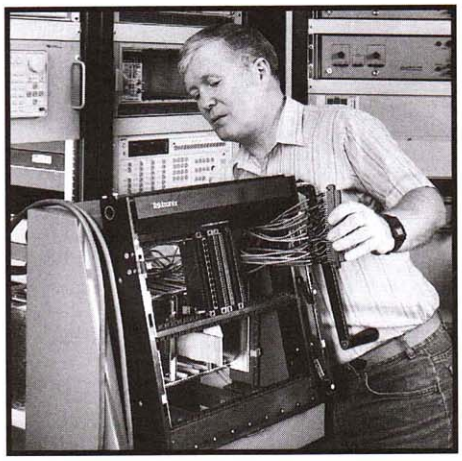
CUSTOMER SITE SUPPORT AGREEMENTS
You call us, we do the rest. We provide rapid response at your site by our highly trained technical support specialists, with the right spares to get your system up and running right away. Where applicable, Tektronix also provides preventive maintenance and calibration services at your site as part of the agreement.

TOTAL–SITE HARDWARE AND SOFTWARE SUPPORT AGREEMENTS
If you have multiple qualifying systems, Total–Site Support may be just what you're looking for. At a very substantial discount from our single–system pricing, we cover all the systems at your site, providing software update services, hardware maintenance and repair, as well as any required preventative maintenance. Since we know every system at your site is covered, there's no hassle with serial numbers to check coverage – we come when you call.

CUSTOMER–SITE SYSTEM ENGINEERING/APPLICATION SUPPORT
For qualifying systems, we provide system engineering support right at your site, helping you with system integration and/or helping you develop application software to maximize the utility of your Tektronix system.

Depot Services

The following services are provided at the nearest designated Tektronix Service Center:



EXCHANGE SERVICE AGREEMENTS
For a nominal fee, we provide access to our exchange system, giving you next–day receipt of replacements for your failed module when you call. We take your failed module, refurbish it to like–new condition, and place it in our exchange inventory.

REPAIR AND RETURN SERVICE
We provide three–day turnaround (exclusive of shipping time) on your failed module when you return it to us for repair.

STANDARD PRICE CALIBRATION OR PERFORMANCE VERIFICATION
On a per–incident basis, Tektronix provides MIL–STD–45662A calibrations, or full performance verifications to manufacturer's specification, as applicable.

CALIBRATION OR PERFORMANCE VERIFICATION AGREEMENTS
Tektronix provides MIL–STD–45662A calibrations, or full performance verification to manufacturer's specification, as applicable. We also provide recall notification, and do it at a discount from our per-incident rates.

Custom Service Agreements

With all the system options we provide, we know that there are times when our standard offerings may not give you exactly what you need. We are happy to discuss your needs and tailor a custom Service Agreement to fit them exactly.

Telephone Support Hotline

Tektronix provides telephone support via nationwide 800–numbers to resolve hardware and software operability, system integration, and fault–isolation issues.

COMPREHENSIVE SYSTEMS SERVICES

- Customer Site Services
- Depot Services
- Custom Service Agreements
- Telephone Support Hotline

Our Unconditional Service Guarantee

"If, for any reason, our services fail to fully meet your requirements as promised, we will resolve the problem at our expense."

ORDERING INFORMATION

CONTACT INFORMATION
Contact your Tektronix sales representative or any Tektronix Sales and Service office for additional service information. Or request a copy of the new Tektronix Test and Measurement Service brochure with accompanying inserts detailing service options. See pages 536 through 539 for the Tektronix office nearest you.

Service Agreements

Our Unconditional Service Guarantee

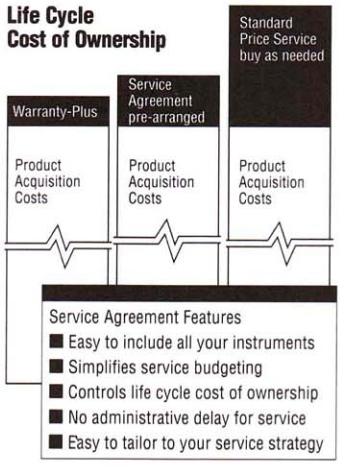
"If, for any reason, our services fail to fully meet your requirements as promised, we will resolve the problem at our expense."

SERVICE AGREEMENTS

- Low Cost Protection
- A Variety of Offerings
- Discounts May Apply

Low Cost Instrument Protection

Once your product warranty or Warranty–Plus coverage expires, consider the cost effectiveness of purchasing a Service Agreement. Service Agreements provide a substantial cost advantage over per-incident Standard Price service costs. Agreements offer service protection purchased in increments of one to several years. Multi–year coverage minimizes your paperwork and affords you tighter control over your ownership costs. Most important, Service Agreement protection helps you maximize your instrument uptime and performance.



CALIBRATION, REPAIR, AND SYSTEMS AGREEMENTS

Service Agreements are available for calibration only, repair only, and as a calibration and repair combination. Comprehensive Systems Service Agreements are available for many Tektronix Test and Measurement Systems and feature calibration and repair protection along with access to our Telephone Support Center and extended software support.

REDUCED COST OF OWNERSHIP WITH NO SPECIAL CONDITIONS

Tektronix Service Agreements foster a disciplined approach to providing superior quality, performance and value by assuring in advance that any care your Tektronix product needs will be provided. Instruments maintained in this manner perform faithfully and experience an extended useful life, which translates into a lower cost of ownership.

ADDITIONAL COST SAVINGS

Aggressive discounts can be added together to reduce support costs below the already favorable basic agreement prices.

MULTI–YEAR DISCOUNT

Multi-year discounts are available on Service Agreements of two or more years.

QUANTITY DISCOUNT

Significant discounts may be applied to Service Agreements covering a number of instruments.

DOLLAR VOLUME DISCOUNT

If you expect to make a substantial investment in repair and calibration services during the year, you may qualify for discounted pricing based on the value of the services you have already purchased from us. Ask a Tektronix Service Account Manager for information about our Dollar Volume Discount Program.

ELIGIBILITY

Products covered by a new product or service warranty, Warranty–Plus Repair Protection, or an existing Tektronix Service Agreement are automatically eligible for Tektronix Service Agreement coverage. Other products require inspection to determine eligibility for coverage under a Repair or Comprehensive Systems Service Agreement. To avoid possible inconvenience, we can waive inspection on most products for a fee.

ORDERING INFORMATION

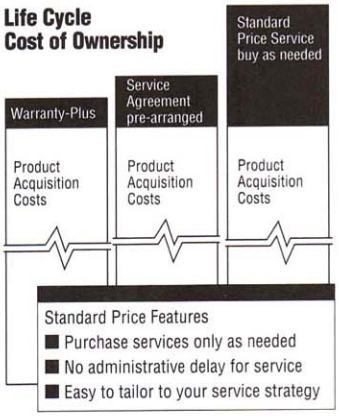
CONTACT INFORMATION

Contact your Tektronix sales representative or any Tektronix Sales and Service office for additional service information. Or request a copy of the new Tektronix Test and Measurement Service brochure with accompanying inserts detailing service options. See pages 536 through 539 for the Tektronix office nearest you.

Standard Price Service
Supplemental Service

Standard Price Service

Tektronix offers calibration and repair services for most products on a Standard Price basis. This lets you make a service decision without waiting for a quote, allowing us to go to work for you right away.



STANDARD PRICE CALIBRATION

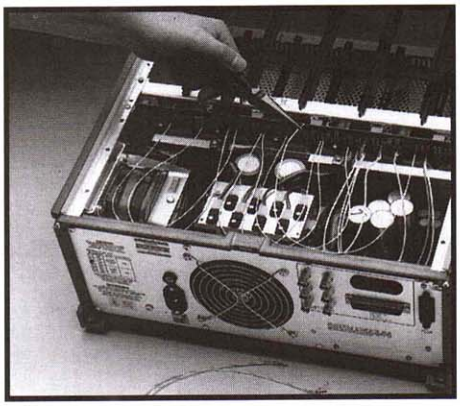
Our calibration program is designed to ensure the continued accuracy and precision of your instruments. It provides NIST traceability and MIL–STD–45662A compliance at no additional charge, on all eligible products. This includes a Certificate of Traceable Calibration and a calibration label showing our certification date and the due date for the next calibration. The Certificate of Traceable Calibration describes your instrument's condition, the measurement standards we used, and the environmental conditions at the time of calibration. Your product is entered into our calibration records and recall system. We notify you when it is time to schedule recalibration to maintain your instrument's certification, and we maintain audit documentation of your instrument's performance in compliance with MIL–STD–45662A.

STANDARD PRICE REPAIR

Tektronix will repair your instrument as you request, installing any component modifications needed to make the repair, and then conduct a front panel check, verifying externally accessible adjustments, to enable your instrument to be calibrated to perform within its specifications. To ensure optimum performance, we encourage you to have us calibrate your instrument when we repair it.

A FEW EXCLUSIONS KEEP OUR STANDARD PRICES LOW

Standard Prices generally cover all labor and parts. Some major, high reliability components



are billed separately on the few occasions they are needed. Products that have been damaged through accident or improper use may be ineligible for Standard Price.

Supplemental Service Information

ADDITIONAL SERVICES ASSURE YOU OF PREMIUM VALUE AT NO EXTRA CHARGE

We treat every instrument service as an opportunity to deliver the extra care that sets Tektronix apart from other service providers. We install up–to–the–minute safety modifications in accordance with the latest Tektronix engineering change orders. We alert you to any performance problems you may want to consider correcting, and if there appears to be an application or operator error, we may phone with technical suggestions to improve your success. Finally, we verify the appearance of your instrument and correct minor cosmetic flaws before packaging it with the appropriate certifications and returning it to you.

DIMENSIONAL STANDARDS SERVICES

Calibration and Repair of your dimensional tools are available at selected Tektronix Service Centers. Tektronix Dimensional Service offers superior quality, convenience, and value. Contact your local Tektronix service representative for detailed information.

TIME AND MATERIAL

Products that are obsolete or that have been damaged or abused are serviced under Time and Material charges with hourly labor rates and parts usage prices applied.

INCIDENTAL SERVICES

Other services offered are: Before and After Test Data Recording, Instrument Wash, Shuttle Services, Pick up and Delivery, and Next Day Calibrations.

STANDARD PRICE SERVICE

Services Available:

- Product Calibration
- Product Repair
- Dimensional Tools
- Obsolete Products

Our Unconditional Service Guarantee

"If, for any reason, our services fail to fully meet your requirements as promised, we will resolve the problem at our expense."

ORDERING INFORMATION

CONTACT INFORMATION

Contact your Tektronix sales representative or any Tektronix Sales and Service office for additional service information. Or request a copy of the new Tektronix Test and Measurement Service brochure with accompanying inserts detailing service options. See pages 536 through 539 for the Tektronix office nearest you.

Reconditioned Products

An ideal solution for stretching the tight budget dollar.

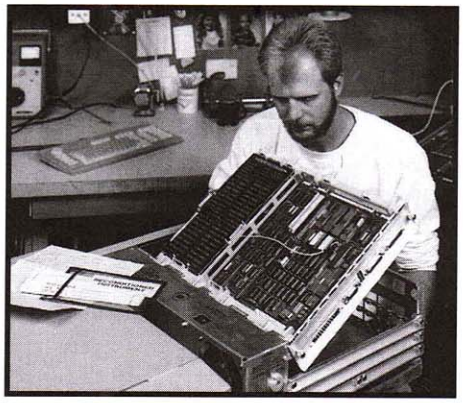
- New Product Warranty
  - Products meet Tektronix high standards for performance, quality and reliability.
- Reduced Prices
- Quick Delivery
  - Many products are in stock and are immediately available.
- Current and Out-of-Production Products May be Available

Reconditioned Products

If budget restrictions are in the way of getting the Tektronix product that you would like to have – Tektronix Reconditioned Products, with the same warranty as a new product, may be an ideal solution for stretching the tight budget dollar.

THE ORIGINS

Tektronix Reconditioned Products are usually field, marketing, or training demo units. Products meet Tektronix standards for quality and performance, both technically and aesthetically. Both current and out-of-production products may be available for sale.



Reconditioned Products meet Tektronix standards for quality and performance.

PERFORMANCE

Tektronix Reconditioned Products are serviced, calibrated and tested to meet the same high quality standards as new products. All essential upgrades are installed and all products are functionally equivalent to new products and meet full product specifications. All reconditioned products are provided with standard manuals and accessories.

REDUCED PRICES

Tektronix Reconditioned Products are usually sold at reduced prices – below new product prices. All standard and contract discounts normally apply.

WARRANTY

We are confident in the reconditioning process. The warranty on current Tektronix Reconditioned Products is the same as on new instruments. Extended service options are also available on most products.

Reconditioned Products look as good as they run.

APPEARANCE

We like our products to look as good as they run. Instruments are inspected and cleaned so they visually are near new. If necessary, we refurbish or replace cabinet parts that do not meet our high standards.

Reconditioned Products are calibrated and tested to meet the same high standards as new products.

AVAILABILITY/DELIVERY

Reconditioned Products are offered on an "as-available" basis. Many products are in stock and are immediately available.

Your Tektronix Account Manager or local Tektronix field office will be glad to see if there is a Reconditioned Product available and to provide you with a current price quote.

ORDERING INFORMATION

Check with your local Tektronix Field Office to take advantage of Tektronix' Reconditioned Product bargains.

Or you may call the National Marketing Center Toll free line: 1-800-426-2200 (Test and Measurement Products).

Your Tektronix Account Manager will be pleased to discuss your instrument needs.

Training and Seminars for Users and Service Technicians

Test and Measurement Product Service Training Classes

Professional training provides your technicians the opportunity to learn the latest maintenance techniques in the same courses used to train Tektronix technicians. We emphasize the "How to Fix" philosophy.

Our formal classroom training is intensive, with lectures and hands-on labs. Tektronix product service training instructors sharpen your skills in troubleshooting, isolating faults, and repairing Tektronix products. You learn factory-approved maintenance procedures for long product life and maximum uptime.

Customized on-site product service training is available. We have the flexibility within our programs to provide training at your location, enabling you to save costly travel expenses. By tailoring the class presentations and materials to your exact needs, you receive maximum value for your training investment.

INSTRUMENT USER AND MEASUREMENT TECHNIQUES WORKSHOPS

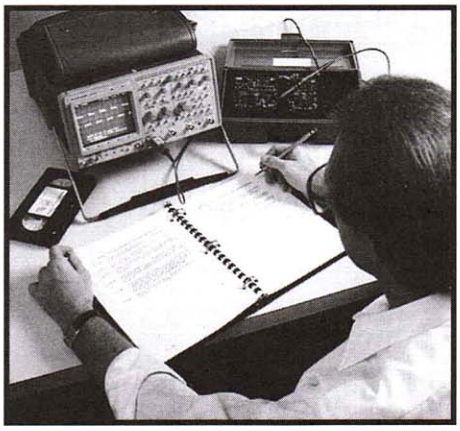
Maximize the efficient utilization of your Tektronix products by subscribing to one of the many Instrument User and Measurement Techniques Workshops offered by Tektronix Test and Measurement Training. These workshops combine classroom lectures with plenty of hands-on labs that emphasize the "Make Measurements" philosophy.

These workshops may be conducted at your location and customized to satisfy your needs. This high quality training increases your productivity and provides you with the instrument familiarity necessary to excel in your profession. Tell us what you need and see what we can do for you. Call today 1-800-835-9433 x WR1407.

TEST AND MEASUREMENT SELF-STUDY MATERIALS

Study on the job or at home. We offer self-study video/audio tapes and training packages which include exercises to help you quickly develop product familiarity and skills in fault diagnosis and repair.

Tektronix Test and Measurement product user self-study training packages provide interactive, hands-on instruction for comprehension of product operation and applications. Test and Measurement product service packages cover troubleshooting and repair techniques at your own bench. Our tapes are quality products that progress from basic concept packages for



novice technicians to advanced concept packages for experienced service specialists. Build your own library of relevant training tapes and materials. Training packages are the next best thing to being in class. Refer to page 394 for Self-Study package content and ordering information.

TEST AND MEASUREMENT TRAINING DOCUMENTATION

Tektronix Test and Measurement Training develops the complete program for your training needs. In addition to formal training, we can create for your use a complete instructor package consisting of: class outline; lesson plan; instructor guide; student workbook; lab exercises; and visual projections. Service manuals, created by the Test and Measurement Training group, can be developed to satisfy your specific needs. Our professional technical writers develop materials which emphasize the "How to Fix" techniques used by the Tektronix service specialist.

Our training programs have been used by various branches of the Armed Services with high acclaim. Join the team of professionals using training offered by Tektronix Test and Measurement Training.

TEST AND MEASUREMENT PRODUCT AND TECHNOLOGY SEMINARS

Tektronix offers a wide variety of free seminars ranging from product specific seminars to test and measurement technology seminars. Learn about the latest technology advances in the test and measurement field or about the latest product features. We want to support you in your need to stay on top of the rapid advances in technology. To receive information on seminars, call your local Tektronix sales office and have your name added to the seminar mail list.

TEST AND MEASUREMENT (T&M) CUSTOMER TRAINING OFFERINGS:

- T&M Product Service Training
- T&M User and Measurement Techniques Workshops
- T&M Self-Study Material
  - Self-Study Packages
  - Video Tapes
  - Audio Tapes
- T&M Training Documentation
  - Instructor/Training Guides
  - Service Manuals
- T&M Product and Technology Seminars

Join the growing number of Tektronix-trained customers.

ORDERING INFORMATION

To register for the formal training classes or for information on other training services, contact: Tektronix, Test and Measurement Training, Walker Road Industrial Park. Attention: T&M Training Registrar, P.O. Box 4600, M/S 94-925, Beaverton, OR 97076. Phone: (800) 835-9433 ext. WR1407.

Formal classroom training is available at the Tektronix training facilities in Beaverton, Oregon, as well as in Atlanta, GA; Boston, MA; Chicago, IL; Dallas, TX; Denver, CO; Irvine, CA; Santa Clara, CA; and Washington, D.C. On-site classes and workshops are also available upon request.

Purchasing/Ordering

Terms of sale to meet varied purchasing objectives.

- General Terms of Sale
- GSA Contracts
- OEM Components
- Rental/Leasing
- Tektronix Sales Offices
- TekDirect
- Tektronix Distributor

General Terms of Sale

CREDIT AND PAYMENT TERMS

Tektronix, Inc. offers many different terms of sale in order to meet varied purchasing objectives and to assist in financial planning. Credit accommodations must be arranged with Tektronix' credit department. Orders and requests for credit accommodations should be placed with your local Tektronix sales office.

If, in the judgment of Tektronix, the financial condition or payment record of the Buyer at any time does not justify shipment of order on the payment terms requested, Tektronix may refuse to ship unless it receives payment in advance, or at its option, payment upon delivery of equipment. Businesses established for six months or less may not meet minimum requirements for extended and/or installment terms of sales.

The following terms may be arranged with a Tektronix Sales Office:

Net 30 Days Standard Terms

Standard terms of sales are net 30 days following the date of invoice. There are no discounts for early payment.

60, 90, and 120 Days Extended Terms of Sale

Extended terms of 60 to 120 days are available on the same single payment basis as standard terms. Since the cost of extended terms is not included in catalog prices, a service charge is added to the invoice. The amount of the service charge depends upon the number of days the terms are extended. Request for extended terms must be made at the time of order placement.

MINIMUM ORDER

The minimum acceptable order is $25.00.

SHIPMENT

All prices, quotations, and shipments are FOB Beaverton, Oregon, unless otherwise specified. Shipment will be made via the most economical method, and air shipments will be insured at full value unless your order instructs otherwise.

Attention: Federal Government Buyers

Tektronix, Inc. has General Service Administration Multiple Award Schedule Contracts for many products listed in this catalog. These contracts are:

- Instruments and Laboratory Equipment; FSC Group 66, Class 6625, Part II, *Section H*
- Instruments and Laboratory Equipment; FSC Group 66, Class 6625, Part II, *Section J*
- General Purpose ADP Equipment and Software; FSC Group 70, Part I, *Section A*

For information on Tektronix products available under these contracts, or to obtain a copy of a Tektronix authorized GSA Price List for one of the above contracts, contact your Tektronix Sales and Service office, or call 1-800-682-1210.

Rental/Leasing Program

Tektronix Authorized Rental Companies provide the widest selection of well-maintained Tektronix instruments, with flexible and attractive terms. For short term rentals, leases and lease purchase options, Tektronix Authorized Rental Companies provide the right terms, the right instruments, the right options so you can make the right choice.

Our Authorized Rental Companies can provide you a solution when you want to try out new equipment before you purchase or when you need equipment for short-term projects or for an immediate requirement. They will provide you the best answers for managing your test equipment inventory, whether you rent it for a month or lease it for a year.

When you need Tektronix products, you will not need to look further than our list of Authorized Rental Companies. Trust your rental and leasing requirements to the very best, Tektronix and...

Continental Resources, Inc.	**1-800-937-4688**
Electro Rent Corporation	**1-818-787-2100**
G.E. Rental/Lease	**1-800-GE-RENTS**
G.E./Leasametric, Inc.	**1-800-553-2255**
Genstar Rental Electronics, Inc.	**1-800-422-3300**
McGrath RentCorp	**1-800-352-2900**
McGrath RenTelco	**1-800-233-5807**
Telogy, Inc.	**1-800-TELOGY-I**
AT&T Capital Corporation Instrument Services	**1-800-874-7123**

Purchasing/Ordering

OEM Components

At Tektronix, we offer many products with terms, conditions, and pricing for OEMs. Computer graphics components, small screen displays, certain cameras, TV signal test and measurement instrumentation – we offer these and other products on a special basis to the original equipment manufacturer.

- **Choose the performance Level to Match Your System**

In many product areas, our wide range of OEM components allows you to select just the optimal performance you need for the system you are building. When your systems demand highest performance, Tektronix will provide the quality products to meet your standard. In price-sensitive situations, the wide Tektronix selection usually allows you to select exactly the performance level you need – no more, no less.

- **Special OEM Terms and Pricing Help Keep You Competitive**

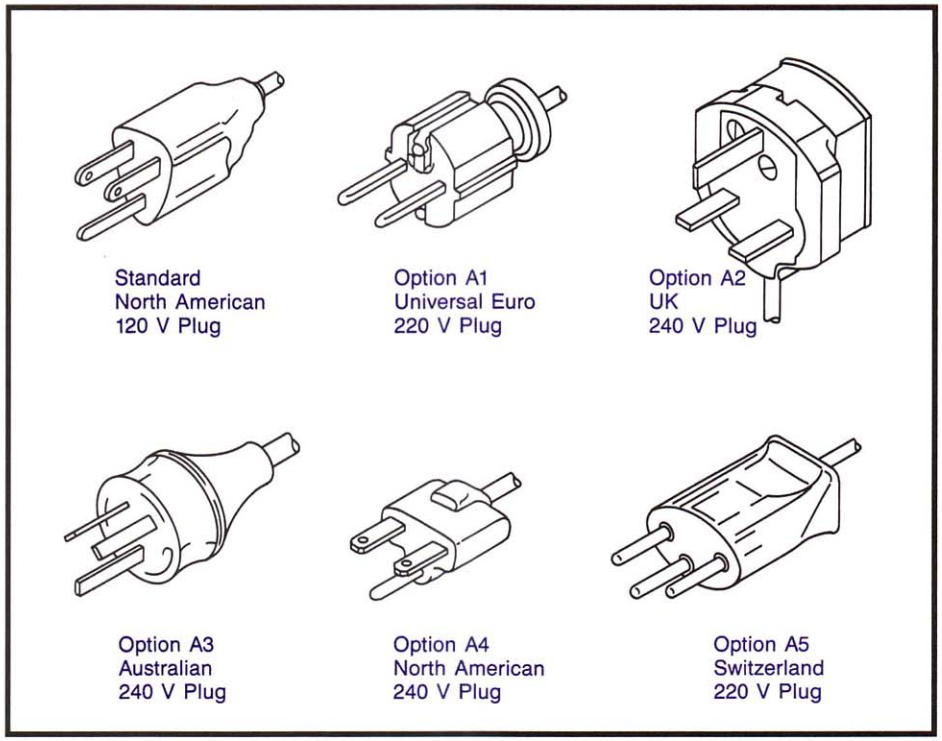
Ask your local Tektronix representative about the special OEM terms and pricing available to you.

- **Service and Support – When and Where You Need It.**

Tektronix has service centers throughout the U.S. and in many countries around the world. We offer long term parts support to protect your investment. If you need applications assistance, we are ready to help. Our OEM specialists are trained to help solve interface problems. That is solid support when you need it.

- **You and Tektronix – A Quality Partnership**

Explore the advantages of working with Tektronix: excellence in products, support, and service. Your local Tektronix representative can help you obtain full details on how you can profit from a quality partnership with Tektronix. See how our OEM expertise can add value to your system.



Power Sources

Most Tektronix instruments provide wide-range regulated supplies, or quick change line-voltage selectors for convenient selection on line-voltage operating ranges. Transformer taps in other instruments can be changed to accommodate specific line-voltage operating ranges or can be factory wired for a specific range if specified on the purchase order.

Many Tektronix instruments are designed to operate from a power source that will not apply more than 250 Volts RMS between the supply conductors or between either supply conductor and ground.

The power cord/plug options may become available on instruments not specified in this catalog. Refer to the individual product ordering information for those products offering these options as of publication date.

Except for some double-insulated instruments, most Tektronix instruments are equipped with either a three conductor attached power cord or a three-terminal power-cord receptacle. The third wire or terminal is connected directly to the instruments chassis to protect operating personnel.

Power-cord coding follows one of the two following schemes:

	Scheme 1	Scheme 2
Line	Black	Brown
Neutral	White	Light blue
Ground (safety earth)	Green-yellow	Green-yellow

POWER SOURCES

Many Tektronix instruments can be fitted with one of the power cord/plug options listed and wired for the voltage as indicated, if specified on the purchase order.

Standard	North American	120 V
Opt. A1	Universal Euro	220 V
Opt. A2	United Kingdom	240 V
Opt. A3	Australian	240 V
Opt. A4	North American	240 V
Opt. A5	Switzerland	220 V

Application Notes

To obtain a free copy of any of the Application Notes listed, just contact your nearest Tektronix representative. When requesting an Application Note, please include the appropriate order number as indicated.

Title/Description	Order Number
Oscilloscopes	
DIGITIZING, DIGITAL + ANALOG STORAGE	
TDS Series	
TDS 640 Debugging Application	11142
TDS Display Modes	40010
TDS 400 HiResolution	40011
TDS 400 Video Trigger	40012
TDS Acquisition Modes	40058
TDS Advanced Triggering	40059
Real Time vs. Equivalent Time	40060
HFS Signal Management	40103
Picosecond Measurements	40104
Prop. Delay Setup & Holdtime	40115
DSA Series/11000 Series	
DSA600 Constellation Display Application	11144
11400 Auto Timing Measurements	40039
11400 Equivalent Time	40040
11400 Probes	40041
11400 Enhanced Accuracy	40042
11400 Using Windows	40043
11400 Single Shot Digitizing	40044
11400 Time Measurements	40045
11800 Sampling Primer	40046
11800 SD Series Sampling Head	40047
DSA600 Scanning Stored Waveforms	40048
DSA600 Series De-Jitter	40049
DSA600 Smoothing	40050
DSA600 Interpolation	40051
11403 High Resolution Timing	40052
11403 Measurement Statistics	40053
11800 Coupled Lines Differential	40054
11800 Differential Ohms Measurements	40055
DSA600 Intel	40056
Power Supply Test & Evaluation	40109
DSA600 FFT Spectral Estimation	40110
Statistical Data Base	40111
TB-Color Grading/Statistical DB	40112
2400 Series	
2400 Series Mate/CIIL	40001
2400 Series Complex Timing	40002
2430A	40003
2430A TV Waveform	40004
T1 Signal Quality	40005
2400 Series Resolution Energy	40006
DSI Mask Testing SW Algorithm	40007

Application Notes

Title/Description	Order Number
200 Series	
222 Uninterruptible Power Supply	40027
222 Differential Measurement	40116
More Than Sample Rate	40028
222PS Troubleshoot Power Elect.	40029
ANALOG STORAGE	
2400 Series	
2445/ 2465 Video Measurement	40008
Digital Video	40009
BrightEye - Microchannel Plate	40105
2200 Series	
2225 Trace & X-Y Phase	40037
2225 Setup & Analysis	40038

Digitizers

SCD Series ESD Events	40033
High Bandwidth Digitizer	40034
Rapid Sequential Digitizers	40035
High Resolution Digitizers	40036

Spectrum Analyzers

Spectrum Analyzer Fundamentals	11024
Spectrum Analyzer Wideband Amplifier Performance	11143
Spectrum Analyzer Dynamic Range Meas.	11145
271X Tracking Generator	11151
271X CATV Applications	11172
2782 Phase Noise	11184
Random Noise Measurement	40119
2782 Microwave High Spectrum Analyzer	40120
494AP Carrier Frequency Shift Measurements	40121
49X AMD/275X Spectrum Analyzers	40122
492PGM Microwave Spectrum Analyzer	40123
Television RF Measurements	40124
EMI Measurements with Preselector	40125
Pre-Amp	40126
Choosing a Preamplifier	40127
Spurious Free Signal Range	40128
Sweep Time in Spectrum Analysis	40129
Signal to Noise Ratio	40131

To obtain a free copy of any of the Application Notes listed, just contact your nearest Tektronix representative. When requesting an Application Note, please include the appropriate order number as indicated.

Application Notes

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Title/Description	Order Number
Logic Analyzers	
DAS9200 Series	
92DM12 80486SX/ 80487SX Support Application	11146
DAS9200 & IBM PC/XT/ZT Host	40061
DAS9200 SW VHXIC Signal Levels	40062
DAS9200 Graphics Display	40063
DAS9200 92HS8 External Async	40064
DAS9200 P6461 Probe Use	40065
DAS9200 92A16	40066
DAS9200 1 Button DC Power	40067
LV500 CMOS Device Testing	40068
LV500 DUT Loading Effects	40069
LV500 Full Scale Signal	40070
DAS9200 200 MHz Stim. Response	40071
DAS9200 92SX109/ 92SX118	40072
DAS9200 Using Symbols	40073
DAS9200 92A16 Intermodulation Signal	40074
DAS9200 50 & 100 MHz Combination	40075
LV500 Variable Timing	40076
LV500 ECL	40077
DAS9200 92A16	40078
DAS9200 Trans Sel Por Files	40080
DAS9200 92A16/ 92S16 Intermodulation	40081
DAS9200 91HS8/ 92HS8 Configurations	40082
DAS9200 68030 Disassembler	40083
DAS9200 92A90 Interim I860 M.S.	40084
DAS9200 VME Bus Interface	40085
DAS9200 with ECL Logic	40086
DAS9200 Keyboard Macros	40087
DAS9200 Centrak Operating Modes	40088
DAS9200 Centrak Theory of Operation	40089
DAS9200 Centrak Adjacent Procedures	40090
DAS9200 Modified IC Chip Performance	40091
SERIES 3000	
Series 3000 Importing into Aldus	40094
Series 3000 Correlate Data	40095
Series 3000 30DM27/ 30DD27	40096
Series 3000 30MPX PDT Operation	40097
Series 3000 Increasing PDT Functionality	40098
1230 Series	
1230 GPIB Interfacing Feature	40030
1230 Data Compare	40031
1230/PC RS232	40032

Application Notes

Title/Description	Order Number
Telecommunications	
Measuring Fiber Optic Return Loss	11195
Application Note - Two Levels of Measurement	40026
CSA803 Mask Testing	40057
OIG 502 Optical Reflection Test	40106
Fiber Optic Transmitter Standards	40107
Optical Extension Ration	40108
1750 S	40117
FiberScout Echos & Reflections	40118
System Solutions	
Automated Power Hybrid Test System	40013
Airline Auto Pilot Test System	40014
Disk Drive Head Test System	40015
High-Density Continuity Test	40016
Automating Production Test System	40017
Telephone Switching Board Test	40018
Propagation Delay Test System	40019
Acc. Timing Controller Testing	40020
Serial Test Improves Throughput	40021
EMC Systems Readiness Testing	40022
Superconductivity Verification	40023
Automotive Engine Module	40024
Automated Service Deopt Testing	40025
VX4820 Pin & Strobe Timing	40092
VX4280 Interface Considerations	40093
Instrument Controllers/Software	
Integrated Systems/Single Shot	40130
Modular Instruments	
TM500 Analog Multiplexer	40101
TM500 AA501	40102
Accessories	
PROBES	
High Frequency/Active Probes	
FET Probe Primer	40099
Floating Scope Measurements & Safety	40100
Microwave Probes Calibration	40113
Probing High Frequency/Digital Circuits	40114

To obtain a free copy of any of the Application Notes listed, just contact your nearest Tektronix representative. When requesting an Application Note, please include the appropriate order number as indicated.

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(503) 682-3411
(800) 426-2200